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GENERAL AND MISCELLANEOUS

20476 (BMI-1504(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1961. Contract W-7405-eng-92. 103p.

Reactor Materials and Components. The stresses required to produce creep rates of 0.001, 0.01, and 0.1 %/hr at 650, 800, and 1000°C were measured for Nb–2.37 wt.% Cr, Nb–3.34 wt.% Zr, and Nb–5.21 wt.% V; anneals of these three alloys showed recrystallization only for heat treatment at 1260°C. Fabrication of miniature heating elements and thermocouples for a power-balancing thermal neutron flux sensor is described. Fuels. Rolling properties of Nb–10 wt.% U and Nb–20 wt.% U at 1000°F are described. Air oxidation tests were made at 1100°F for the following compounds: $(Th_9U)C$, ThC · 10UC · 5NbC, ThC · 10UC · 5SiC, ThC · 10UC · 2.5Mo_2C, ThC · 10UC · 5ZrC, $(Th_9U)C_2$, ThC_2 · 10UC_2 · 5NbC, ThC_2 · 10UC_2 · 5SiC, ThC_2 · 10UC_2 · 2.5Mo_2C, and ThC_2 · 10UC_2 · 5ZrC. Hardness measurements on Th–5 wt.% Pu and Th–10 wt.% Pu show that complete recrystallization occurs within 1 min at 700°C. X-ray diffraction studies indicate Nb–25.6 wt.% Pu–6.1 wt.% Si to consist of free Nb and Nb_5Si_3. Sintering and melting experiments on PuO_2 in Ar and H_2 show that melting is caused by the existence of Pu_2O_3 in Ar or by reduction of PuO_2 to Pu_2O_3 in dry H_2. Compatibility tests with PuO_2 pellets encased in types 304, 316, 318, and 347 stainless steel and Inconel, run for 2 hr at 1900 or 2000°F in H_2, gave no evidence of failure. An equation is presented which describes the in-pile steady-state release rate of fission products from dense plates. Fuel Element Development. A reaction layer was found at the interface between type 304 stainless steel cladding and UN-type 347 stainless steel cerments gas-pressure bonded at 2300°F. Fabrication of UN cerments is described. Experiments conducted with compacted mixtures of plastic binder, stainless steel powder, and UO_2 powder are described. Development of Uranium Carbide. Cores of UC and UC–10 wt.% Mo_2C were hot pressed at 1480°C, and density measurements before and after sintering are reported along with particle-size data. Uranium carbide melts were cast; analyses of castings gave 5.1 ± 0.3 wt.% C. Phase studies of as-cast U–5.9 wt.% C and U–6.5 wt.% C were conducted which show UC–UC_2 mixtures and indicate a eutectic in the UC–UC_2 system. Diffusion studies gave a preliminary value of 5×10^{-8} cm^2/sec for the self-diffusion coefficient of C in UC at 1600°C. The research program on radiation effects on UC is described briefly. Growth of UO_2 Single Crystals. Experiments using a high-temperature tungsten resistance furnace to grow single UO_2 crystals from melt are reported. It appears that tungsten is compatible with molten UO_2 and that dissociation of UO_2 does not occur up to its melting point. Radioisotope and Radiation Applications. The use of Mn^{54} in studies of Mn removal from solutions was studied and found to be feasible. The effects of molecular weight on radioinduced site formation (free radicals) in polymethyl methacrylate was studied and found to decrease the site formation. Preirradiation treatment was found to increase site formation in polymethyl acrylate. Site vs dose data for polyvinyl acetate are presented. Development of UN. Experiments carried out to investigate fabrication of high-density UN bodies are described. The results of immersion tests of UN samples in water and in steam are discussed. Experiments were conducted on arc-melting production of UN in order to study the variables of arc and furnace control at high N_2 pressures. An attempt to produce a homogeneous UC–UN phase was made but failed. Fuel surface temperatures for UN under irradiation were estimated for both unclad and clad specimens. UN samples were exposed to NaK-Al at 500°F for 1000 hr; no evidence of gross attack was found. Materials Evaluation. Corrosion rates of several Fe- and Ni-base alloys in fused NaCl–KCl–U_3O_8 sparged with Cl_2 at 750 to 800°C were determined in order to evaluate them for possible use as container material for the HAPO fused chloride-electrolytic fuel-recovery (UO_2) process. Coated-Particle Fuel Materials. Al_2O_3-coated UO_2 particles were subjected to a series of screening tests to evaluate their suitability for in-pile testing. The tests included hardness measurements, thermal cycling, crushing, oxidation, leaching by HNO_3, and postirradiation Xe^{133} release. UO_2 particles were coated with pyrolytic carbon to study the effect of temperature and deposition rate on the coating. The results indicate that coatings prepared below 1500°C are superior. Postirradiation Xe^{133} releases were determined for UO_2 particles coated with ~36 μ carbon. Graphite matrices containing Al_2O_3-clad depleted UO_2 were fabricated and its properties measured. Results are presented for two oxide matrix sintering experiments in which dispersions of Al_2O_3 in Al_2O_3 + talc and of Al_2O_3-clad UO_2 in Al_2O_3 were made. The design and performance of a beam-tube furnace for use in an irradiation facility are described. Postirradiation studies of graphite spheres containing Al_2O_3-coated UO_2 particles are presented, and possible causes of the observed cracking of the Al_2O_3 coatings are discussed. The conclusions of a study of the effects of coated fuel particles on the reactivity of a pebble-bed reactor are pre-

sented. Work done on fission-gas analytic techniques is described. Diffusion coefficients were measured for Xe^{133} in α alumina at 807 to 1495°C. Dissolution studies on the effects of electrolytes on uncoated, high-fired UO_2 spheres at 95°C indicate K_2CrO_4 to be less corrosive than H_2CrO_4 or H_2SO_4. Metallographic examination of UO_2 particles coated successively with Al_2O_3 and C and heated in vacuum at 1800°C for 4 hr showed no reaction between Al_2O_3 and C or between Al_2O_3 and UO_2. Calculations were made on the corrosion rates of Al_2O_3 and MgO in air, N_2, steam, and CO_2 at 100-atm pressures. Methods are being considered for measuring the thermal conductivity of specimens containing coated fuel particles. Recovery of Spent Reactor Fuel Elements. A combined hydrofluorination-corrosion study with BeO was carried out using a $NaF-ZrF_4$ molten salt at 570°C sparged with HF. After 120 hr, ~50% of the added BeO (576 g) dissolved, and the INOR-8 coupons showed low corrosion. Two B & W pins and two ORR pins, all irradiated to burnups in the 20,000 Mwd/t range, were dissolved by Sulfex-Thorex and Darex-Thorex processes. Decladding and dissolution of cores were essentially complete. Fueled Graphite Elements for Pebble-Bed Reactor. The alpha emission rates of pyrolytic carbon-coated UC_2 particles were measured both before and after leaching with 1:1 HNO_3, and the leach solutions were analyzed for U content. The particle density distribution of these leached fuel particles is also given. Alpha counting of Al_2O_3-coated UO_2 particles after oxidation in static air for 5 hr at 1200°F showed no increase, and neutron activation testing of these particles indicated a high degree of Xe^{133} containment at 1600 to 2500°F. Cold Bonding of Zircaloy-2 to Type 410 Stainless Steel. In a study of friction techniques, several variations of joint design were tested. It was found that material upset can be controlled by employing a mild steel mandrel in the bore of the mating materials during the bonding operation. The problem of shearing in Zircaloy is discussed. A brief study was made of relative component reduction to determine where bonding can most easily be achieved; the best bonding obtained corresponded to reductions of 55 to 60% in Zircaloy and 37 to 40% in stainless steel. Explosive joining techniques were also investigated. Bonding of flat-plate assemblies was obtained when a 16-g charge of PETN was used in direct contact with the assembly, but pockets of a Fe–Zr intermetallic were formed at the interface. Several explosive butt-welding tests gave no bonding. Gas-Cooled Reactor Program. The oxidation resistance of Al_2O_3-coated UO_2 particles after sintering and/or pressing was determined and found to be poor, probably due to failure of the Al_2O_3 coatings. The high-temperature fatigue characteristics of Hastelloy X tubing was studied; maximum stresses of 30,000 and 11,500 psi are required to promote 10^6 cycle failure at 1400 and 2000°F, respectively. It is concluded that the fatigue behavior of Hastelloy tubing is related to the structure prior to testing. Corrosion of Thorium and Uranium. Metallographic examination of Ni-Cr-plated Th that blistered during exposure to water-saturated air at 200°F showed the failures to be within the Th metal and not in the Th-Ni interface. Outgassing at 500°F in vacuum was found to prevent blistering of plated Th. Various combinations of Th, U, and U–10 wt.% Mo (soldered and welded combinations, couples with other metals, and alone) were exposed to 100% humidity at 120°F for 2500 hr. The soldered joints involving U separated after 500 hr; welded coupons showed no effects attributable to the welds; and no galvanic attack was noted in the dissimilar metal couples. U–10 wt.% Mo and Ni-plated Th showed corrosion resistances superior to those of bare U and Th. Gas-Pressure Bonding of Be-Clad Elements. Specimens containing Be in contact with coated UO_2 cores were bonded at 1650°F for 4 hr at 10^4 psi. Metallographic examination revealed a reaction between Be and a graphite-coated core, while no reaction was observed between Be and a pyrolytic carbon-coated core. (D.L.C.)

20477 (BNL-646) NUCLEAR ENGINEERING DEPARTMENT PROGRESS REPORT, MAY 1–AUGUST 31, 1960. (Brookhaven National Lab., Upton, N. Y.). 66p.

Reactor Physics. Work is reported on reactor physics studies of the BBRR, on PWR reactor physics evaluations, and on Pu-fueled reactors. Further work on the detailed comparison of theory and experiment for water lattices was carried out. The equal charge displacement rule was applied to calculations of fission product poisoning. Results are reported on the effect of temperature on Xe instability, on flux trap reactors, on analysis of the Snell experiment, on neutron thermalization, and the effect of anisotropic scattering for various cases. The importance of the spatial distribution of neutron sources on the asymptotic neutron spectrum was demonstrated. Monte Carlo calculations of the fast effect in U and Be systems were completed. Work was continued on the water lattices, Dy^{164} and Eu^{151} cross section measurements, pulsed neutron experiments, and the BBRR critical experiments. The activation cross section of Dy^{164} in the energy region 0.06 to 2.0 ev was also measured. Pulsed neutron measurements of GBF graphite and Bi continued. Chemistry and Chemical Engineering. Radiation experiments on aromatic fluorocarbons were started. A new technique for measuring the absorption spectra of very strongly absorbing materials is being developed for particular application to fused salts in the ultraviolet. Films of a micron or less are sandwiched between silica flats. Spectra were so far obtained on $PbCl_2$ and KI. Thermodynamic properties of liquid Na–Bi alloys in the high-sodium region were obtained by a vapor pressure technique. A satisfactory Re-graphite thermocouple was constructed and operated up to 2300°C. Experiments were performed to determine whether Xe or I diffuse through reactor cladding. Preliminary postirradiation meltdown studies were performed to simulate a reactor temperature excursion leading to a fuel element meltdown. Specifically, the fission products I and Xe were investigated as to the effect of meltdown temperature, time of meltdown, and the resulting distribution of these fission products in the experimental apparatus. An investigation was completed in which it was established that the predominant mechanism by which Xe is sorbed into graphite at high temperatures is that of pore entrainment and thus dependent on the porosity of the graphite. Work was initiated on the adsorption of I on graphite at high temperatures. As part of an analytical study of heat transfer to liquid metals flowing in concentric annuli, results were obtained for the case of heat transfer through the outer wall only. Fuel material consisting of uranium carbide in graphite was successfully treated with the Nitrofluor reagent, NO_2-HF mixture. The solid disintegrated to a powder and the U went into the liquid phase, from which it was recovered in nearly 100% yield. The liquidus line of the freezing-point vs. composition diagram of the system NO_2-HF was determined in the region 0 to 45 mole % HF. Heavy gamma irradiation was found not to impair the subsequent ability of NO_2-HF to dissolve Zircaloy. Infrared absorption spectra indicate the existence of strong interaction, if not compound formation, between NO_2 and HF in mixtures of the vapors. A decontamination factor of 1.1×10^6 was demonstrated for Cs^{137} removal from a high salt content waste stream. Development work is continuing on aqueous processes for Zircaloy and SS-clad UO_2 fuels. Observance of a

long induction period before the reaction of UO_2 with a calcium amalgam persisted. Equipment is being assembled and tested for high temperature physical property measurements. Preliminary results are presented in the N_2-O_2 system and the NH_3-H_2O system. A research irradiator is being constructed. A low-level source for dose distribution studies in finite targets was prepared. Investigation of the Zr–HCl reaction in an Al_2O_3 fluidized bed was continued. Results are also given for an experiment in which SS was reacted with Cl_2 in a static bed. Methods were studied for suppressing bulk ion interference in the processing of Purex type waste by absorption on mineral ion exchange materials. A program was started to study the formation of phosphate glasses as a means of incorporating the fission products in stable media. Hot Laboratory. Dowex-50-W was shown to perform similarly to Dowex-50 with respect to the elution of Y^{90} in a Brookhaven Y^{90} generator. Experiments not yet completed indicate that calcium phthalocyanine (Ca–Pc) is not as unreactive as the original experiments indicated. Satisfactory reproducibility was firmly established for a flame photometric procedure for determining Ca in mixtures of water-cyclohexanone-TTA, and for the extraction of Ca from such mixtures by water and by hydrochloric acid. Very rough preliminary measurements indicate a cross section around 10 ± 30 mb for the $Ti^{50}(n,\alpha)Ca^{47}$ reaction with 14-Mev neutrons. Two full-scale preparations of Cu^{67} were made via the $Ni^{64}(\alpha,p)Cu^{67}$ reaction using enriched Ni^{64}. The 61-hr half-life of Cu^{67} was confirmed. The $Sb^{121}(\alpha,n)I^{124}$ reaction was used to produce about ¼ mC I^{124} with a yield of about 100 mC/mah. The production of pure Sc^{47} from CaO was shown to be feasible. In assaying Ar^{38} for isotopic content via mass spectrograph, it was found that the normal Ar contamination occluded inside glass itself is sufficient to vitiate the analysis when the sample is introduced into the spectrograph by melting the glass capillary tube containing it. An electroplate having a thickness of a few microns is required as a protective cover over an alpha-emitting needle which is being fabricated. A technique involving the use of the electron microscope was developed for measuring the thickness of such a plate to within a fraction of a micron. The preparation of several Curies of very pure Kr^{83m} is being undertaken for Project Matterhorn. Development of a procedure for milking the positron-emitting Ga^{68} from its long-lived Ge^{68} parent was begun. Calculations and preliminary tests indicate that the use of fully enriched Mg^{26} instead of natural Mg in the production of Mg^{28} is both feasible and economical. A direct comparison is being made of the ≧13 Mev neutron flux produced by thermal neutron irradiation of Li^6D and of U^{235}. Experiments were begun to test a proposal for continuously measuring B concentration in blood and a modification of this proposal which will allow the continuous production of very short-lived radioisotopes and the use of such isotopes for localized irradiation of selected sites in vivo. The reaction between tri-n-octylamine (R_3N) and 2-thenoyltrifluoroacetone (HT) has been investigated and found to be $R_3N + HT \rightleftharpoons R_3N \cdot HT$. Radioactive tracers established the validity of an ashing procedure for the spectrographic determination of Mg in blood. The flame photometric estimation of fluoride in solutions of Zircaloy proved infeasible. An investigation of the feasibility of molten sulfate as a medium for electrochemical studies was begun. The density of $Li_2SO_4-K_2SO_4$ eutectic at 625°C was found to be 2.12 ± 0.01 g/ml. Titration of Cl^- released when the sulfate was passed through the chloride form of Dowex-1, readily gave accurate assays of the eutectic. A low-melting $LiNO_3-KNO_3$ eutectic affords the possibility of using Hg electrodes for electrochemical studies. The apparatus for such studies was assembled, and preliminary experiments indicated that the half-wave potential for Pb and Cd are identical. Investigation of the Bi-pool electrode demonstrated that Bi metal and LiCl–KCl eutectic can be purified so that oxide contamination is no longer a problem. The Zn–Bi system was studied, and the diffusion coefficient of Zn in Bi was found to be 5.2×10^{-5} cm^2 sec^{-1} at 450°C. The diffusion coefficient of Li in Bi at the same temperature was found to be 2.1×10^{-5} cm^2 sec^{-1}, and the activity coefficient was found to be 4×10^{-7}. The stability, resolution, and reproducibility of the new incremental polarograph are excellent. The applicability of contact radiography in identifying active electrode sites at which electron transfer processes may selectively occur is being studied. Well-defined contact radiograms were produced by Tl^{204} tracer in deposits which had an average thickness ranging from 10 to 1500 A. Optimum conditions for activation analysis of Au in biological tissue were determined. Exploratory studies of organic disulfide compounds indicated that disulfide-sulfhydryl reduction in compounds like cystine and glutathione disulfide can be carried out coulometrically with 100% current efficiency. Prices of all processed isotopes in routine production have been reviewed and adjusted in order to put this production on a self-supporting basis. The Waste Concentration Plant was shut down for approximately 1 month while leaks were located in an auxiliary steam coil and a new coil fabricated and installed. Metallurgy. Nearly all thermal convection loops containing U–Bi were shut down; emphasis was shifted to loops containing Hg and Na. Steel thermal convection loops containing inhibited Hg under pressure operated at ΔT for over 1500 hr without detectable corrosion or precipitation. At high velocities, corrosion and cavitation-like attack by inhibited Bi were much more severe on 2¼ Cr–1 Mo steel than on 1¼ Cr–½ Mo steel. Measurements of the emf between steels immersed in Bi as a function of Cr content showed a pronounced electropositive maximum at ~5% Cr. Solubilities of Mg and Sm in Bi were redetermined. Stripped films formed on steels by reaction with Zr–Bi melts possibly contain carbides and nitrides (of Si, Cr, Fe) along with the ZrN. Ion bombardment of a steel surface, followed by Bi-vapor deposition on the surface, did not appear to improve uniformity and reproducibility of Zr-bearing surface films on steels after contact with Zr–Bi melts. The rate of formation of Zr film appeared to be diffusion-controlled. The Radiation Loop has operated in-pile for 1817 hr, of which 1552 hr were at ΔT condition, without difficulty. Modification of the Hot Cell to permit cryogenic testing of irradiated specimens is proceeding. A revised graphite monitoring and Radiation Damage Program for the graphite in the BNL reactor was made. Pore volume studies with natural graphite powder showed that the volume available to Hg penetration is inversely proportional to the compacting pressure. Hg that penetrated the pores under pressure was only partially released upon release of pressure. Approximately ⅓ of the total pore volume of AGOT graphite outgassed 1 hr at 500°C is inaccessible. A program to measure the rate of release of gaseous fission products from uranium carbide powders was initiated. Blisters that appear on the surface of the fuel elements for the graphite reactor during storage probably result from inclusions in the U–Al alloy meat which penetrate the clad during rolling. Heat treatment improved the properties of the steel used in the telescope plates of the Greenbank Observatory by refinement of the grain size. Fission fragment damage to thin evaporated films resulted in tracks visible under transmission electron microscopy.

A high temperature vacuum furnace was built to produce the high purity Fe. Development work on Mo brazing of graphite continued. An apparatus was built to determine the effects of cycling temperature gradients on the fuel elements for the BBRR. Capsule experiments show that migration of Th and U through slurries of their intermetallic compounds in Bi is due to the temperature coefficient of solubility and to convection currents in the slurry. Mechanical Engineering. The new 7-ft spherical containment vessel was designed for the critical experiments. It is intended to use the existing pump, piping, etc., and couple directly to the spherical tank by means of flanged joints. The design for the control rod plate locations and accessory equipment is in progress. Modification were made to the tank for the BBRR Fuel Handling Mockup. All equipment for the BBRR Fuel Element Test Loop was delivered. Erection of the Mercury Test Loop–Mark IV framework and piping was completed and all components were installed. Pipe and fittings for the NaK Heat Transfer Loop were received. A reference design for the test section was completed. A conceptual design was completed for a Laminar Fluidized Bed Reactor. An evaluation of the economics of this system was made. A preliminary flow sheet and cost estimate was made for a High Temperature Critical Facility. All three fans for the Brookhaven No. 1 Research Reactor were installed. Early indications show that the power savings will amount to about $10,000/month. Cell layouts and equipment specifications were completed for the High Level Radiation Development Laboratory. New control rod mechanisms and supporting framework were designed, fabricated, and installed for the Facility for Criticality Measurements of Slab Lattices. A measurement platform for the UO_2 Rod Lattice Assembly was designed, fabricated, and installed. The in-pile hole mockup assembly for the Dry Irradiation Facility–Mark IV was fabricated and installed in the basement of the Graphite Reactor Building. The production cost estimate of the Nitrofluor Process was completed. A cost estimate and plant design was prepared for a reprocessing facility utilizing the method of halogenation and fluorination of fuel elements in a fluidized bed. The Irradiation Facility is to be used by MIT to establish dose rates and other basic data for the irradiation of foods and other materials. Reactor Evaluation. The review of the status of direct conversion programs was completed. Theoretical work and exploratory experiments were initiated on a pulsed fission plasma device. The chemonuclear studies were directed toward the investigation of the radiation polymerization of ethylene. Evaluation of the suspended fuel concepts continued. (auth)

20478 (CEX-58.9) A MODEL DESIGNED TO PREDICT THE MOTION OF OBJECTS TRANSLATED BY CLASSICAL BLAST WAVES. I. Gerald Bowen, Ray W. Albright, E. Royce Fletcher, and Clayton S. White (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Jan. 1961. 55p.

A theoretical model was developed for the purpose of predicting the motion of objects translated by winds associated with "classical" blast waves produced by explosions. Among the factors omitted from the model for the sake of simplicity were gravity and the friction that may occur between the displaced object and the surface upon which it initially rested. Numerical solutions were obtained (up to the time when maximum missile velocity occurs) in terms of dimensionless quantities to facilitate application to specific blast situations. The results were computed within arbitrarily chosen limits for blast waves with shock strengths from 0.068 to 1.7 atm (1 to 25 psi at sea level) for displaced objects with aerodynamic characteristics ranging from those of a human being to those of 10-mg stones and for weapon yields at least as small as 1 kt or as large as 20 Mt. (auth)

20479 (HW-69345) COMMENTS ON EUROCHEMIC TECHNICAL REPORT NO. 81. R. E. Burns (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 20, 1961. Contract AT(45-1)-1350. 4p.

The comments refer to the availability and welding of Type 304-L stainless steel, the choice of alloy materials for constructing head-end equipment, development studies of chromium–nickel alloys, and corrosion data for the nickel-base alloys Hastelloy-F, Ni–O–Nel, and Carpenter-20. (For reference to EUROCHEMIC Technical Report 81 see NP-9807.) (B.O.G.)

20480 (IA-620) RESEARCH LABORATORIES SEMI-ANNUAL REPORT FOR THE PERIOD JULY–DECEMBER 1960. (Israel. Atomic Energy Commission, Tel-Aviv). 93p.

Nine critical experiments were carried out in the Israel Research Reactor. The control rod worth was measured in some of the critical experiments by the reactor period and rod drop methods. The effect on the reactivity of the core of the water-filled beam tubes, pneumatic tube, and thermal column associated with the stall position was measured. Power distributions within the core and relative burnup of the fuel elements were estimated by measuring thermal and epi-thermal neutron flux through the core. The gamma flux was also measured using an activation technique. Relative intensities of thermal neutrons were measured using thin foils of dysprosium–aluminum alloy. Cascade calculations of meson (μ) transitions in the mesonic atom were made in order to obtain further insight into the problem of the "missing x-ray" involved in the capture of meson (μ) in light elements. The reaction cross sections of high-energy N-N collisions were calculated as a function of the effective N-N cross section in nuclear matter. The interaction of heavy cosmic ray particles in nuclear emulsion was investigated with regard to the production of mesons and energetic fragments. In a study of fast hyperons emitted from multi-nucleon K^- captures at rest, 65 such events were found. A search for the D^- meson was conducted in an emulsion stack exposed to the 300 Mev/c K^- beam at Berkeley. Further measurements were made on the distribution of zinc between anion exchanges and chloride solutions. The anion exchange behavior of lutetium and dysprosium in lithium nitrate solutions was investigated. Anion exchangers for work in fused salts are being investigated. The equilibrium exchange chloride-perchlorate on Dowex-1 was remeasured in order to determine the chloride fraction in resins in equilibrium with a perchlorate ionic medium containing some chloride. An analysis of the uranyl nitrate–TBP system revealed that certain published data may be quantitatively accounted for by thermodynamic expressions. The solubility of ruthenium tetroxide in nitric acid measured at 25°C was found to increase with nitric acid concentration. The work on pyridine-N-oxide polymers was continued. Unstable uranium complexes with common inorganic ions were studied. The method of focusing electrophoresis developed by Schumacher was evaluated to determine its applicability to rapid separation problems. Paper chromatography was used to determine the substances contained in the OPPA extracting mixture. Ion exchange uranium absorption experiments were carried out on acetic acid extracts of roasted phosphate rock and on similar synthetic solutions. A theory was developed which explains the relationship between the structure and the scintillation ef-

ficiency of organic liquid scintillators. Preliminary experiments demonstrated radioinduced oxygen exchange between OH^- radicals and oxyanions in chlorates, sulfates, and nitrates. Lithium salts of various orgainc compounds were irradiated and the behavior of the radioactive fluorine atoms formed investigated. It was found that orthoiodoanisol is quantitatively deiodinated by Fenton's reagent ($H_2O_2-Fe^{2+}$) in the concentration range from 10^{-4} to 10^{-5}M. A method for the determination of Sr^{90} in soils is given, based on the use of Sr^{85}-labeled strontium carrier. The deuterium concentration in heavy water was determined by the reaction $O^{16}(d,n)F^{17}$. Recoil separation of F^{18} nuclei from the reaction $F^{19}(n,2n)F^{18}$ was investigated. F^{18} was produced on irradiating Li_2CO_3 by the reactions $Li^6(n,\alpha)t$ and $O^{16}(t,n)F^{18}$. These reactions were also used to determine the oxygen content of inorganic materials. A procedure for the determination of mercury impurities in urine by radioactivation was proposed. A method was developed to determine small quantities of tellurium in the presence of very large quantities of bismuth. A flame photometric method was used for the determination of cesium in the presence of microquantities of calcium and strontium. Uranium, aluminum, and iron were determined in Al–Fe–U alloys. A semi-quantitative chromatographic method was applied for the determination of silver in the presence of bismuth. Color fading due to the presence of uranium was encountered in determining chromium in uranium metal by colorimetric methods. The addition of lanthanum was found to counteract the depressive effect of PO_4 interference in the flame photometric determination of strontium and barium. The effects of cations on the flame photometric determination of lithium in the Dead Sea waters were studied. The results of a general radiogeological survey are discussed. The rate of deiodination of thyroxine in vivo was followed in rats. Attempts were made to utilize the disturbances in the blood brain barrier for detection and location of brain tumors. Radioisotope scanning was used to study pathological conditions of the liver. A model of the transport of nuclear bomb debris in the stratosphere and through the tropopause was developed. A cancellation circuit was designed for use with a continuous air monitor to suppress variations in background activity due to varying climatic conditions. A transistorized preamplifier was designed for use with 10-dynode photomultipliers. A transistorized logarithmic amplifier was designed for use with a 20-channel pulse height analyzer. A transistorized scaler was developed. A list of publications issued during the period is included. (M.C.G.)

20481 (NP-9363) RAPPORTO DI ATTIVITA PER GLI ANNI 1958, 1959. PARTE PRIMA, PARTE SECONDA. (Report of Activities for the Years 1958, 1959. Parts I and II). (Italy. Comitato Nazionale per le Richerche Nucleari, Rome). 1960. 340p.

A two-part report of γ activities of the CNRN for 1958–59 is presented. Part one describes the internationalization of the Center at Ispra, reactor development for Italy, nuclear fuels, prospecting, research and study centers, radiobiological research, and international participation in converences and meetings. Part two explains the CNRN organization and discusses the activities of each unit. (T.R.H.)

20482 (NP-10101) RELAZIONE SULLA MISSIONE TECHNICO–NUCLEARE NEGLI STATI UNITI D'AMERICA, SETTEMBRE 1959. (Report on the Technical Mission to the United States of America, September 1959). (Associazione Nazionale per il Controllo della Combustione. Comitato per la Sicurezza e l'Economia degli Impianti Nucleari, Rome). 1960. 366p.

A trip report on the Italian technical mission to USAEC installations is given. The scope of the mission is briefly described. Then the AEC development program and the legislation controlling the American nuclear industry are reviewed. The principal topics studied by the mission were plant security, construction materials, reactor vessels, inspection, radioactive wastes, and transport of radioactive materials. The nuclear plants visited are described with respect to these topics. (J.S.R.)

20483 (SCR-406) EXPLOSIVE CRATERING EXPERIMENTS. Luke J. Vortman (Sandia Lab., Albuquerque, N. Mex.). May 1961. 11p. For Sandia Corp., Albuquerque, N. Mex.

Experiments with high explosives are described which were carried out to learn how nuclear explosives can be used to break up and remove material for large-scale excavations. It is concluded that the experiments established the feasibility of using this explosive technique in such development during the nuclear test moratorium. (J.R.D.)

20484 (TID-4025(1st Rev., Pt. I)) TRANSLATION TITLE LIST AND CROSS REFERENCE GUIDE. PART I. Frances E. Stratton, comp. and ed. (Office of Technical Information Extension, AEC). June 1961. 519p.

A list is presented of the unclassified translations in the files of the Office of Technical Information Extension on June 30, 1960. Most of the listed translations were announced in NSA. The majority of the translations are available at Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. or from Special Libraries Association Translation Center, John Crerar Library (JCL), Chicago, Ill. (J.R.D.)

20485 (WT-731) BLAST DAMAGE TO CONIFEROUS TREE STANDS BY ATOMIC EXPLOSIONS. Project 3.19 of OPERATION UPSHOT-KNOTHOLE. Fred M. Sauer, W. L. Fons, and Theodore G. Storey (Forest Service. Div. of Fire Research). Jan. 1954. Decl. Dec. 29, 1960. 84p.

A tree stand covering approx. one and one-fourth acres and composed of 145 ponderosa pines was exposed to an overpressure from atomic explosions. Maximum deflections were measured for all trees, and strain distribution and acceleration measurements were made on selected isolated trees. Data are tabulated. Correlation between measured and predicted tree breakage is discussed. (C.H.)

20486 (UCRL-Trans-663(L)) UNDERGROUND EXPLOSIONS. PLUTONIUM AND NUCLEAR ARMS. Camille Rougeron. Translated by D. A. Nimidoff from Forces Aeriennes Francaises, 45-66(1960). 30p.

The use of underground explosions to produce plutonium and other radioisotopes for military and peaceful uses is discussed. The underground explosions would produce plutonium starting from U^{238}, and U^{233} starting from thorium. Neutrons would be produced from a thermonuclear explosive consisting of one stage of fusion serving as a starter and one stage of fission. The use of an underground chamber partially filled with water would regulate the power of the charge by partial vaporization of this water. The residues of reaction, plutonium and unreacted U^{238} or U^{233} and unreacted thorium, would reassemble in the water. The economy, abundance, purity of product, and simplicity of the treatment are described. It is estimated that a weight of plutonium 20 to 50 times greater than that recovered in one year from a reactor could be produced in a single underground explosion. The production of Co^{60} and Ar^{40} by this method is also discussed. (M.C.G.)

20487 ADVANCES IN SPACE SCIENCE. VOLUME 2. Frederick I. Ordway, III. New York, Academic Press, 1960. 463p.

Reviews and analyses of space physics, tracking, materials, electrical propulsion systems, and attitude control are presented. Space vehicles are used for experimental physics in this study. Outside of the topic on space material, the subject matter is concerned with satellites and space vehicles. (N.W.R.)

20488 DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SEVENTH CONGRESS, FIRST SESSION, FEBRUARY 21, 23, 24, 27, 28, MARCH 1, 2, AND 3, 1961. (United States. Congress. Joint Committee on Atomic Energy). 812p.

Topics discussed in detail include materials technology problems in the nuclear power industry, coordination with the atomic energy programs of our allies, regulatory problems, and industrial aspects of the nuclear space program. Statements submitted for the record, pertinent correspondence, and miscellaneous appendixes are included. (C.H.)

20489 FUNDAMENTALS OF ROCKET PROPULSION. Raymond E. Wiech, Jr. and Robert F. Strauss. New York, Reinhold Publishing Corp. and London, Chapman and Hall, Ltd., 1960. 151p.

A general introduction to the field of space propulsion consisting of the principles of operation of the rocket, its capabilities, and its limitations is presented. Both liquid and solid propellants are discussed in terms of preparation, properties, and action in the rocket engines. The rocket engine is discussed in terms of design, operation, and theory. Rocket engines of the future are also discussed and their operation in space is considered. (N.W.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

20490 (AD-239788) ANNUAL RESEARCH PROGRESS REPORT [ON STUDIES ON RADIATION AND THERMAL BURNS]. (Brooke Army Medical Center, San Antonio). June 30, 1960. 177p.

Progress is reported in studies of clinical changes induced by radiation and thermal burns in patients and experimental animals. Data are included from studies on seratonin metabolism in burned patients and experimental animals; blood serum haptoglobin levels in man following thermal injury; the influence of environmental factors in burns; weight gain response and oxygen consumption in closely related postburn rats from different sources; the effects of burns in the early postpartum period in rats; oxygen consumption in the male rat postburn at different environmental temperatures; postburn mortality and total eschar slough in male and female rats postburn; ventilation studies in the burned patient; effects of burns on biochemical composition of blood and on weight of rats; urinary tract infections in burned patients; antibiotic therapy of infections in burned patients; the diagnosis of infections in burned patients; the clinical operation of a burn center; the effect of massive occlusive dressings on the normal adult male; the effects of early excision and grafting of extensive areas of full-thickness burns; and results of clinical pathological studies of fatal burn injuries. (C.H.)

20491 (AD-251491) A STUDY OF CHEMICAL CHANGES PRODUCED BY HEAT AND BY IRRADIATION OF MEAT AND MEAT FRACTIONS. Report No. 7 (Progress) [for] March 24, 1960–June 23, 1960. W. A. Landmann (American Meat Inst. Foundation, Chicago). Contract DA-19-129-QM-1293. 3p.

Separation of the components of phospholipid material obtained from irradiated meat was continued. Water distillation of the fractions containing the "wet dog hair" odor yielded a white waxy material which condensed in the bore of the water cooled condenser. The condensed material had a strong off-odor. Chemical analyses were performed on this material. Positive tests obtained by two procedures suggested the presence of either a sulfonic, sulfinic, sulfonamide, or sulfone group. (auth)

20492 (AD-251512) DIP COAT PACKAGING OF IRRADIATED FOODS. Report No. 10 (Progress) [for] February 15, 1960–May 14, 1960. L. J. Bratzler (Michigan State Univ., East Lansing). Contract DA-19-129-QM-1195. 2p.

Boneless pork loin roasts and Cornish Game Hens were placed in fibrous Visking casings, cooked, frozen and coated with Dow and/or Wasco hot melt before or after irradiation of 6 megarads. Storage at 0°F and 100°F, 90% relative humidity was begun. The higher storage temperature resulted in the loss of all samples after 4 weeks. Taste panel results at the beginning of storage showed that the non-irradiated samples were more acceptable than the irradiated products. (auth)

20493 (AD-251587) DEVELOPMENT OF IRRADIATION STERILIZED MEAT PRODUCTS. Report No. 5 (Progress) [for] January 15, 1960–April 14, 1960. W. J. Stadelman (Purdue Research Foundation, Lafayette, Ind.). Contract DA-19-129-QM-1364. 10p.

Loss of tenderness of enzyme inactivated poultry meat frozen prior to irradiation may be due to the enzyme inactivation method or the level of irradiation. Maximum effects of each were not additive. One megarad irradiated poultry meat stored for 60 days at 32°F was acceptable on all measures of quality. (auth)

20494 (TID-12897) A. TECHNICAL PROGRESS REPORT [ON THE UPTAKE OF STRONTIUM BY VARIOUS TYPE CROPS AND FACTORS AFFECTING UPTAKE AND TRANSLOCATION OF STRONTIUM AND CALCIUM NATIVE TO SOIL]. (Arizona. Agricultural Experiment Station, Tucson and Arizona. Univ., Tucson). [nd]. Contract AT(11-1)-947. 49p.

The effects of various crop residues, soil amendments, and certain agricultural chemicals on the movement of strontium through soil columns which were intermittently leached with water were studied in order to obtain basic information for the control of contamination of soils by radiostrontium. The movement into soil of radioactive calcium, strontium, and phosphorus from contaminated crop residues which came in contact with the soil was also investigated. A calcareous desert soil, Superstition sand, was selected for use in this study. The elements were applied to the surface or mixed into the upper one inch of the soil both in organic crop residues or as inorganic acids or salts. The calcium, phosphorus, and strontium moved through the soil more readily when they were incorporated in organic residues than when applied as inorganic salts or acids. Moreover, applied inorganic strontium as well as soil calcium moved most readily where acetic acid, $CaCl_2$, $Si(NO_3)_2$, or organic residue were applied. A duplicate experiment employing Tucson sandy loam was carried out for comparative purposes. The effectiveness of various amendments upon the leachability of labeled strontium increased in the following order: none, irrigation water, elemental sulfur, disodium EDTA, gypsum, calcium chloride, acetic acid, and strontium nitrate. The movement of indigenous soil calcium was almost quantitatively similar in both soils. In order to determine if the exchange of radiostrontium for calcium in the crystal lattice is of importance in calcareous soils, the exchange of radiostrontium and also radiocalcium with caliche of several particle sizes was studied. After 24 hrs about 20% of the labeled strontium and 6% of the labeled calcium remained in solution. (M.C.G.)

20495 (TID-12946) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. Progress Report, September 1, 1960–August 31, 1961. John H. Ryther and David W. Menzel (Bermuda Biological Station, St. George's West). June 1, 1961. Contract AT(30-1)-2646. 13p.

The current status of projects on plankton ecology and cycles of elements between living and non-living phases of the systems in the Sargasso Sea is described and some of the results given. High concentrations of NH_3 were found in the surface waters, often exceeding by an order of magnitude the amounts of nitrate and nitrite. The algae Trichodesium thiebautii was found to fix free N_2. It was found that inorganic P may be bound by surface active agents to bubbles, which may account for the higher phosphate levels observed in surface waters. The role of iron in the plankton cycle is discussed. Vitamin B-12 was determined in samples collected from various depths. Possible run-off from South America into the sea is discussed. (D.L.C.)

20496 (UCLA-476) STUDIES OF THE TRANSMISSION OF MOUSE LEUKEMIA WITH PURIFIED NUCLEIC ACID

PREPARATIONS. Esther F. Hays (California. Univ., Los Angeles. School of Medicine). June 6, 1961. Contract AT(04-1)-GEN-12. 17p.

A study of the effects of preparations containing purified desoxyribose nucleic acid and ribose nucleic acid prepared from normal and leukemic tissues of a high incidence strain of mice (AKR) when injected into a low incidence ($C3H_f$/Bi) and hybrid ($C3H_f \times AKR)F_1$ strain was carried out. ($C3H_f \times AKR)F_1$ hybrid mice were found to have an increased incidence of leukemia after injection with these nucleic acid preparations by the subcutaneous and intravenous route at 12 to 72 hours of age. $C3H_f$/Bi mice were found to be resistant to leukemogenesis by these nucleic acid preparations. A group of five $C3H_f$/Bi mice developed parotid and adrenal tumors 7 to 10 months after DNA-RNA injection in the thymus at 2 to 5 days of age. (auth)

20497 POSSIBLE ROLE OF POTENTIATORS IN RADIATION THERAPY. Malcolm A. Bagshaw (Stanford Univ. School of Medicine, Stanford, Calif.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 822-33(May 1961).

In retinoblastoma a higher cure rate with less damage to the adjacent normal tissue was demonstrated when TEM was used in conjunction with roentgen radiation. Numerous possibilities for the potentiation of roentgen-ray effects by chemotherapeutic agents have been suggested. Among these, FU and actinomycin D appear to have limited usefulness. The mode of incorporation into DNA of other halogenated pyrimidine analogues such as BUDR and IUDR suggests that these compounds hold promise as potentiating agents. More pre-clinical investigation is indicated in order to select that combination most likely to succeed on a clinical level. In order to prove that the efficacy of roentgen therapy can be increased by chemical potentiation, a long-term study of patients, carefully selected as to neoplastic type, will be necessary. (auth)

20498 RADIOISOTOPES IN BIOCHEMICAL AND ORGANIC RESEARCH. W. A. J. Borg. Atoomenergie Haar Toepassingen, 3: 49-56(Apr. 1961). (In Dutch)

After a short survey over the utilization of stable isotopes, the radioisotopes used in biochemical studies are reviewed. The synthesis of some specific labeled compounds is described. By means of some examples the importance of radioisotopes in the study of metabolic processes such as hormone synthesis, citric acid cycle, and photosynthesis is indicated. 27 references. (tr-auth)

20499 CONTRIBUTION TO THE MEDICAL UTILIZATION OF ARSENIC-76. Lucien Mallet and Bernard Pierquin. Compt. rend., 252: 2964-6(May 8, 1961). (In French)

The effects and therapeutic results on some cutaneous malignancies obtained with As^{76} are reported. (tr-auth)

20500 TRACER DYNAMICS: I. TENTATIVE APPROACH AND DEFINITION OF FUNDAMENTAL CONCEPTS. Per-Erik E. Bergner (Karolinska Institutet, Stockholm). J. Theoret. Biol., 1: 120-40(Apr. 1961).

The tracer system is discussed in terms of two disjoint sets of atoms, the set of tracer atoms and the set of naturally occurring atoms, or the mother substance. The two kinds of atoms have the same atomic number and differ only in respect of the atomic weight, i.e., different isotopes of one and the same element. In terms of elementary set-theoretical concepts two postulates are formulated which together define a stochastic system. As a special case the finite tracer system is defined as a finite Markov chain, and it is shown that this approach gives results equivalent to those usually derived from deterministic models. The methods applied make possible a rigorous definition of concepts such as a general compartment and a compartment with complete mixing. Special attention is devoted to the concept of turnover, which is given a rigorous definition applicable to a large class of compartments. (auth)

20501 KINETIC TELECOBALT THERAPY: METHOD FOR THE RAPID COMPUTATION OF THE DEEP DISTRIBUTION OF THE RADIATION. G. L. Buraggi, A. Romanini, and L. Roncoroni (Università, Milan). Minerva nucleare, 5: 37-44(Feb.-Mar., 1961). (In Italian)

A method for evaluating the deep distribution of radiations in kinetic telecobaltotherapy is proposed. The method is based on the use of graphs of deep transmission which take into account the variable factors during beam pendulation (skin-focus distance, illumination at the body surface, and beam amplitude at surface). The use of these graphs facilitates and reduces the calculations required in selecting the program of treatment and could favor the spread of kinetic radiation methods. (auth)

20502 PROLIFERATIVE CYCLE IN THE GROWING HAIR FOLLICLE OF THE MOUSE. S. M. Cattaneo, H. Quastler, and F. G. Sherman (Brookhaven National Lab., Upton, N. Y.). Nature, 190: 923-4(June 3, 1961). (BNL-4942)

The duration of the intermitotic phases (synthesis of DNA (S phase), preceded and followed by gaps called G_1 and G_2 phases) is measured for the cells of the growing-hair follicle in the mouse by pulse-labeling with tritiated thymidine, followed by serial killing, preparation of autoradiographs, and determination of the fraction of mitoses labeled at various intervals between injection and death. The results show that the duration of the S-G_2 mitosis sequence is fairly constant in a given species, while the duration of the G_1 phase varies widely and is chiefly responsible for differences in generation times, both within and between cell populations. The fraction of mitoses labeled as a function of the interval between injection of label and death is given at times ranging from 10 min to 42 hrs. (N.W.R.)

20503 GEOGRAPHIC VARIATION IN INCIDENCE OF SKIN CANCER IN THE UNITED STATES. Harry Auerbach (Argonne National Lab., Ill.). Public Health Repts. (U. S.), 76: 345-8(Apr. 1961).

From data available for 10 cities in the United States, a quantitative inverse relationship is shown between skin cancer incidence rates for the white population and the degree of latitude of the cities. A constant rate of increase in skin cancer incidence is observed as white populations further south in the United States are studied. The same rate of increase of skin cancer with decreasing latitude is shown for white male and female populations and for each 10-year age group from 25 through 64 years. The incidence rate is doubled for each 3°48′ of latitude, or approximately 265 miles. (auth)

20504 ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. VOLUME VII. Cornelius A. Tobias and John H. Lawrence, eds. New York, Academic Press, 1960. 371p.

The use and effects of radiation in biological and medical physics are presented. The following topics are included: genetic and physiological effects of the decay of incorporated radioactive phosphorus in bacterial viruses and bacteria, micro x-ray diffraction on biological materials, autoradiography with tritium-labeled substances, physiological effects of nuclear radiations on the central nervous system, some isotopic studies on the distribution and metabolism of plasma proteins, radiation carcinogenesis, and mechanisms for the transfer of information from the light

image to the optic nerve discharge of the limulus eye. (N.W.R.)

20505 PROCEEDINGS [OF] CONFERENCE ON RESEARCH ON THE RADIOTHERAPY OF CANCER, JUNE 16-18, 1960, UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. [Supplement to Cancer]. New York, American Cancer Society, Inc., 1961. 198p.

Twenty papers are included; separate abstracts have been prepared for fifteen. The five papers not abstracted treat combined surgery and radiation treatment of cancer, combination radiation and chemotherapy, radioisotopes in cancer treatment, supervoltage therapy, and electron therapy of cancer. (D.E.B.)

20506 NEWER RADIOTHERAPEUTIC SOURCES OF RADIATION AND THE DISTRIBUTIONS THAT THEY PRODUCE IN BIOLOGICAL MATERIALS. H. E. Johns (Ontario Cancer Inst., Toronto and Univ. of Toronto). p.5-15 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Sources of radiation are reviewed and it is concluded that it is unlikely that any new type of radiation that produces a bigger differential effect between normal and healthy cells will be discovered. This being the case, our efforts should be directed toward greater precision in the use of presently available tools. A well designed Co^{60} unit appears to be the most practical method of producing radiation in the average clinic. Methods for increasing the accuracy by which a given dose may be delivered are discussed. Preliminary information on spectral distributions is included that may be of value in radiobiological investigations. (auth)

20507 RADIOSENSITIVITY-TESTING PROCEDURES IN CANCER OF THE CERVIX. James A. Merrill, David A. Wood, and Calvin Zippen (Univ. of California School of Medicine, San Francisco). p.113-21 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

The combination of cytological and biopsy material was found to offer more useful information on the radiosensitivity of cervical cancer cells than either method alone. The smear technique is concerned with the response of normal cells and the biopsy technique with the response of tumor cells. It is shown that in most cases malignant tissue and host tissue respond in a similar fashion and to a comparable degree to the effects of radiation. Despite the value of these methods of radiosensitivity testing it is concluded that the methods offer little to supplement careful clinical evaluation of a specific patient during therapy. (C.H.)

20508 HOST FACTORS AFFECTING THE RADIATION RESPONSE IN CARCINOMA OF THE CERVIX. Manuel Garcia (Charity Hospital, New Orleans). p.133-8 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

A survey is presented of the host characteristics that may influence the outcome of radiation therapy in carcinoma of the cervix. Race, social class, and concurrent disease appear to have no effect inherently on the tumor response. Pregnancy concurrent with the neoplasm favors the outlook, if the duration of the pregnancy is 6 months or less. Patients seen in the last trimester and during the puerperium have a bad prognosis. Anemia, infection, stenosis of the vaginal vault, and urinary abnormalities significantly impair the results. In the case of infection, a slow rate in the administration of treatment improves the response, while in cases of urinary abnormalities, a gain is achieved by irradiating a large volume of the pelvis. The performance of pyelography in cases of urinary abnormalities induces a significant decrease in salvage. Tumor response is decisively impaired if high dosage is given to the periphery of the pelvis. Fruitful data have been obtained in the reports of vaginal cytology of the past decade. The significance of the sensitization response and of a good cytological response are discussed. (auth)

20509 ALPHA PARTICLE PITUITARY IRRADIATION IN METASTATIC CARCINOMA OF THE BREAST. Metabolic Effects. A. Cleveland, J. Braun-Cantilo, G. LaRoche, C. Tobias, J. Constable, J. Born, F. Sangalli, R. Carlson, and J. H. Lawrence (Univ. of California, Berkeley). p.190-5 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

This progress report on pituitary irradiation for advanced metastatic carcinoma of the breast gives further evidence that externally delivered particulate radiation from the 184-in. cyclotron makes it possible to inhibit the function of or to ablate the pituitary gland, with resultant metabolic and morphological changes similar to those observed after surgical hypophysectomy. Particulate irradiation of this type has many interesting characteristics and has possibilities for destroying tumors or creating lesions in neurological tissues. (auth)

20510 RADIOLOGICAL HAZARDS TO PATIENTS. Second Report of the Committee. (Gt. Brit. Ministry of Health). 1960. 114p. (A/AC.82/G/L.557).

The state of knowledge concerning the effects of ionizing radiation on human beings is reviewed. Radiation hazards associated with present practices in diagnostic radiology and the use of radiotherapy in non-malignant conditions are discussed. Data are appended from a survey conducted in Scotland during 1957 and 1958 which showed that medical radiology, both diagnostic and therapeutic, resulted in a genetic dose of 19.3 mr per person per year. (C.H.)

20511 HARTSTRAHLTECHNIK. (Hard Radiation Techniques). Wolfgang Frik. Stuttgart, Georg Thieme Verlag, 1961. 150p. DM 28.50. Available in USA and Canada from: New York, International Medical Book Corporation, $7.50.

The experimental principles of high exposure voltages are summarized, and the application range of hard radiation techniques is defined on the basis of the interpretation of the experimental results. The historic development of these techniques is briefly reviewed as an introduction. Factors affecting the selection of the exposure voltage are discussed. 296 references. (J.S.R.)

20512 GAMMAGRAPH FOR MEDICAL PURPOSES. Archimiro Caha and Kamil Kallusch. Canadian Patent 614,828. Feb. 14, 1961.

A medical gammagraph which produces a quick and reliable diagnosis or treatment by means of gamma radiation is described. The gammagraph consists of a scintillation head with a support means. The support means is supported by the instruments frame and consists of a column rotatable about its vertical axis. Support links are pivotally connected to the head and to the column and permit a vertical displacement of the head. Power means are provided for automatically imparting reciprocating angular movement to the head and the column. A table is set on a base below the head for placing the subject. The table may be adjusted by groove and catch means with respect to the axis of the column and for automatically shifting the table after each reciprocating movement of the head. A recording drum is supported by the frame for reproducing the

movements of the scintillation head with respect to the body. A recording device cooperating with the drum and electrically connected to the scintillation head records the impulses from the scintillation head. (N.W.R.)

Biochemistry, Nutrition, and Toxicology

20513 (CEA-1888) ETUDE DE LA DISTRIBUTION DU Ca^{45} EN FONCTION DU TEMPS CHEZ LE RAT NOUVEAU-NE PAR LA METHODE D'AUTORADIOGRAPHIE A −195°C. (The Study of the Distribution of Ca^{45} With Time in the New-born Rat by the Autoradiography Method at −195°C). Claude Kellershohn and Pierre Pellerin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 11p.

Ca^{45} metabolism was studied as a function of time by autoradiography at −195°C in the new-born rat after subepidermal dorsal injection of 20 micro-curies per animal. This study confirmed: the existence of a rapidly exchangeable calcium bone fraction; a considerable intestinal excretion of radio-calcium, much greater than the urinary elimination; and a gradual transfer of the activity for the long bones of the epiphysial to the diaphysial regions during growth, together with secondary modifications during ossification. (auth)

20514 EXPERIMENTAL STUDIES ON RADIOACTIVE ZINC IN THE MALE REPRODUCTIVE ORGANS OF THE RAT. Bengt Wetterdal (Karolinska Institutet, Stockholm). Acta Radiol., Suppl. 156, 1-83(1958). (In English)

Zinc-65 was given intramuscularly to male rats and the concentration and localization in the reproductive organs was determined by scintillation measurements and radioautography. The experimental techniques used are described in detail. The Zn^{65} showed a differential localization in the seminiferous tubuli of the testis and was found to be transported through the ductus epididymidis and the vos deferens by products from the testis. Observations indicate that the spermatozoa were the transport vehicle of Zn^{65} and that the uptake of Zn^{65} occurred in spermatozoa which were almost ready to leave the seminiferous tubuli. Based on these observations, the time of passage for the spermatozoa from the semineferous tubuli to the caput eipdidymidis was estimated at about 7 days and the time between the caput and the cauda was also estimated to be about 7 days. (C.H.)

20515 CALCIUM AND METABOLISM OF I^{131} IN RATS AND HOMOGENATES OF RAT THYROID. Yaro Ribeiro Gandra and John G. Coniglio (Vanderbilt Univ. School of Medicine, Nashville.). Am. J. Physiol., 200: 1023-6(May 1961).

The goitrogenic effect of calcium was studied by the use of I^{131} in intact rats and in rat thyroid slices. Rats receiving excess dietary calcium had larger thyroids than controls. Enlargement of the thyroid was accompanied by increased content of inorganic iodine and decreased content of organic iodine. In vitro studies showed that thyroid enlargement was associated with greater total iodine uptake. Addition of calcium to the incubation medium decreased the total iodine uptake of thyroid slices. The reduction occurred as a consequence of interference with the conversion of inorganic iodine to organic iodine. No decrease in inorganic iodine content was observed. The ratios of bound iodine to free iodine were constantly smaller in the thyroid groups receiving calcium supplement. The results of the in vitro studies suggest that calcium interference is due, at least in part, to a direct effect on thyroid tissue. (auth)

20516 DISTRIBUTION OF ABSORBED STRONTIUM-85 AND CALCIUM-45 AS INFLUENCED BY LACTOSE. F. W. Lengemann and C. L. Comar (New York State Veterinary Coll., Cornell Univ., Ithaca, N. Y.). Am. J. Physiol., 200: 1051-4(May 1961).

Studies on the absorption and subsequent deposition in bone of Sr^{85} and Ca^{45} injected into ligated sections of small intestine of the rat showed that: more Ca^{45} than Sr^{85} was absorbed from the intestine; especially during the first 4 hr, significantly more of the absorbed Sr^{85} than Ca^{45} was deposited in bone; injection of lactose, lysine, or glucose into the ileum, along with the alkaline earths, caused the absorbed Ca^{45} to deposit in the bone at the same rate as the Sr^{85}, and also caused an increased total absorption of both radionuclides; these observations did not hold for the duodenum or jejunum, confirming differences in mechanism among the sections of the small intestine. Tentative explanations are suggested, the most plausible one being that calcium is bound as it is absorbed from the small intestine and that the presence of lactose in the intestine inhibits the production of the bound form. (auth)

20517 RADIOBIOLOGIC BASIS OF OXYGEN AS A MODIFYING FACTOR IN RADIATION THERAPY. L. H. Gray (British Empire Cancer Campaign Research Unit in Radiobiology, Northwood, Eng.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 803-15(May 1961).

Reaction mechanisms are discussed that are involved in the response to oxygen tension of a population of normal or malignant cells which lose reproductive integrity as a result of exposure to a given dose of ionizing radiation. Data from a series of studies are presented graphically. It is concluded that the curability of some mammalian tumors is limited by the radioresistance of a proportion of hypoxic cells which retain their reproductive integrity. (C.H.)

20518 NEUTRON ACTIVATION ANALYSIS. Richard E. Ogborn, Arthur L. Dunn, Alan J. Blotcky, Gordon F. Johnson, and Lawrence R. James (Veterns Administration Hospital, Omaha, Nebr.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 976-87(May 1961).

Applications of neutron activation analysis in medical science are discussed. It is pointed out that a reactor for medical research must provide a flux of thermal neutrons in the range of 10^{10} to 10^{14} $n/cm^2/sec$. Design characteristics are described of the TRIGA Reactor, Mark I. A brief description of procedures in neutron activation analysis is followed by examples of the use of this technique in clinical studies. (C.H.)

20519 DISTRIBUTION OF POTASSIUM AND CAESIUM-137 IN THE CALF AND THE PIG. R. M. Green, K. G. McNeill, and G. A. Robinson (Univ. of Toronto). Can. J. Biochem. and Physiol., 39: 1021-6(June 1961).

Using a scintillation spectrometer, measurements were made of the distribution of potassium and radioactive cesium in the bodies of the cow and the pig as a result of the ingestion of these materials. The results of these experiments, which are based on measurements of the radioactivity normally found in foodstuffs and in animals, agree with those of earlier experiments in that there is no great concentration of Cs^{137} apparent in any one organ. However, there is evidence for preferential concentration in the kidney and testes. (auth)

20520 INFLUENCE OF COLCHICINE ON LEUKEMOGENIC EFFECT OF X-RAY, ESTROGEN, METHYLCHOLANTHRENE, AND URETHAN IN MICE. Sadahisa Kawa-

moto, A. Kirschbaum, J. J. Trentin, and H. G. Taylor (Univ. of Texas, Houston and Baylor Univ., Houston, Tex.). Cancer Research, 21: 309-13(Apr. 1961).

Colchicine had a significant inhibitory influence on the leukemogenic effect of estrogenic hormone in combination with either x ray or urethan in mice. There was some suggestion that colchicine inhibited the induction of leukemia in mice by x rays. Colchicine was not leukemogenic in low-leukemin strains of mice when administered alone. Colchicine did not affect spontaneous (presumably viral) leukemogenesis in AKR mice. (auth)

20521 ADMINISTRATION OF 5-IODODEOXYURIDINE-I^{131} IN THE MOUSE AND RAT. E. Gambetta Hampton and Maxwell L. Eidinoff (Cornell Univ. Medical Coll., New York). Cancer Research, 21: 345-52(Apr. 1961).

5-Iododeoxyuridine-I^{131} was administered to normal as well as tumor-bearing rats and mice, and the effect of several variables on the disposition of the administered compound and on the I^{131} content of selected tissues was studied. Incorporation of the iodouracil moiety into the DNA of tumor and intestine was demonstrated. Simultaneous administration of a large excess of 5-iodouridine, together with the 5-iododeoxyuridine-I^{131}, did not significantly affect the I^{131} content of tumor and intestine. Administration of the labeled compound intraperitoneally as an oil emulsion rather than as an aqueous solution appreciably increased the incorporation of the iodouracil moiety into the DNA of tumor tissue. Administration of 5-iododeoxyuridine-5′-phosphate did not appreciably alter the incorporation of the iodouracil moiety as compared with an equimolar dose of 5-iododeoxyuridine. (auth)

20522 THE UPTAKE OF SULFUR-35 BY THE CONNECTIVE TISSUES SURROUNDING IRRADIATED SKIN TUMORS. James T. Duhig (New England Deaconess Hospital, Boston). Cancer Research, 21: 485-8(May 1961).

Carcinomas were induced in the interscapular skin of C57L female mice by thrice-weekly applications of benzpyrene. X irradiation of these tumors resulted in an increased incidence of metastasis in irradiated mice compared with unirradiated tumor-bearing control animals. Sulfur-35 was injected into the animals prior to death, and radioautographs of the tumors and tumor beds were prepared. The radioautographs showed a concentration of S^{35} in the ground substance and mast cells about unirradiated tumors and reduction in the amount of radioactive material incorporated into similar structures around irradiated tumors. (auth)

20523 THE DEPOSITION OF RADIOIODINE IN THE THYROIDS OF RATS FOLLOWING INHALATION OF THE VAPOUR. P. J. Barry (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys., 4: 305-7(1961).

Measurements were made of the deposition of I^{131} activity in the thyroid glands of rats after inhalation as a vapor. Data are tabulated. Results indicate approximately 23% retention. (C.H.)

20524 THE BEHAVIOR OF INHALED $Ru^{106}O_2$ PARTICLES. W. J. Bair, D. H. Willard, and L. A. Temple (General Electric Co., Richland, Wash.). Health Phys., 5: 90-8(1961). (HW-64139)

About 24% of total inhaled $Ru^{106}O_2$ was deposited in lungs of mice. Lung retention of deposited Ru^{106} was studied with a whole-body monitor. Radiochemical assay of tissues from mice killed at intervals up to 70 weeks after exposure confirmed retention in pulmonary tissues. Of three exponential components of the lung clearance curve the longest biological half life was 230 days for about 2% of the total lung deposition. Translocation to other tissues was also observed. Several tissues including ovaries and adrenal glands attained greater concentrations, though smaller quantities, than the lungs. The total dose to lung over the 70-week period was estimated to be 4600 rads per μc of total Ru^{106} deposited. An $MPC_{(air)}$ for $Ru^{106}O_2$ of 1.3×10^{-8} μc per cm^3 air for a 40-hr week was derived by assuming lung to be the critical organ and by extrapolating the data from mouse to man on the basis of differences in weight alone, ignoring differences in anatomy and physiology. (auth)

20525 QUANTUM CONVERSION IN PHOTOSYNTHESIS. Melvin Calvin (Univ. of California, Berkeley). J. Theoret. Biol., 1: 258-87(Apr. 1961). (UCRL-9533).

A new suggestion is made based on model work associated with similar measurements on biological material. The primary quantum conversion act is an ionization occuring in a charge transfer complex. This is what it amounts to in chemical terms. But this process cannot occur in isolated charge transfer molecules in solution because the products cannot escape from each other. The primary quantum conversion as it occurs in modern photosynthesis can only take place in a laminated structure where the electrons and holes can escape from each other by electron migration and not by atomic migrations. This is the essential feature introduced here which differs from all the previous notions of how quantum conversion occurs in chemistry or biology. (auth)

20526 STUDY ON RADIOACTIVE CESIUM. EFFECT OF DRUGS ON THE DEPOSITION AND EXCRETION OF RADIOACTIVE CESIUM. T. Kiyota (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi, 33: 1544-50(1959).

Deposition and excretion of radioactive Cs in male rats of the Wistar strain were studied under the influence of DOCA, cortisone, or CsCl as protective drugs or carriers. In rats treated with these drugs the deposition of radioactive Cs in the various organs was decreased with an increase of the excretion in urine and feces. CsCl was most effective, followed by DOCA given 3 times, cortisone and DOCA administered only once. In each group increased excretion of radioactive Cs in the urine occurred immediately after the injection, while that into the feces was observed within a few days. No harmful side effect was recognized after the injection of these drugs. Treatment with DOCA, cortisone, or CsCl may be useful in protecting the body from the deposition of radioactive Cs. (auth)

20527 BIOLOGICAL STUDY OF RADIOACTIVE BARIUM. I. DISTRIBUTION OF ADMINISTERED BARIUM-140 IN THE BODY. E. Endo, M. Tanaka, T. Kojima, S. Hasegawa, T. Shindo, S. Kawada, T. Meguro, and M. Negi (Nihon Univ., Tokyo). Nichidai Igaku Zasshi, 18: 869-74 (1959).

Ba^{140} was injected into the peritoneal cavity of mice to examine its distribution in the body. The results were as follows: (1) Observation carried out on the day of administration showed the highest radioactivity count in the skeletal system, followed by the teeth, liver, kidneys, spleen, testis, heart, and muscles in decreasing order. (2) Radioactivity counted in each organ decreased gradually keeping an approximately exponential relationship with time. (3) The younger group took more Ba^{140} than the older. (4) More calcium of the bone was replaced by Ba^{140} in the younger group than in the older. (auth)

20528 STUDIES ON THE METABOLISM AND RADIATION INJURIES OF Cs^{137}. K. Kamikoda (Osaka Medical School). Osaka Shiritsu Diagaku Igaku Zasshi, 8: 1335 (1959).

Radioactive cesium was taken up initially by soft tissues such as kidney, intestine, and liver, and later by muscles in a high percentage. In lactating rats the tissue concentration of Cs^{137} in the suckling became almost equal to that in the mother. Most of the Cs^{137} was excreted in the urine and only 1/3 in the feces. Single administration of 25 μc of Cs^{137} resulted in disturbances of spermatogenesis in rat tests, and of hematopoietic function, particularly in the erythroblastic series. (auth)

20529 AUTORADIOGRAPHIC STUDY OF THE PROLIFERATIVE ACTIVITY OF LEUKEMIC CELLS WITH TRITIATED THYMIDINE. L. Bussi, D. Taglioretti, F. Pizzi, and P. M. Carrara (Università, Milan). Radiobiol. latina, 3: 209-15(July-Sept. 1960). (In Italian)

Using the technique of autoradiography, the metabolism of desoxyribosenucleic acid in leukemic cells cultured in vitro in the presence of H^3 thymidine was studied. The investigation showed feeble uptake of radioactive thymidine by the undifferentiated leukemic cells of persons affected with different types of acute leukemia and, in certain cases, a distinct correlation between the percentage of labelled cells and the number of leukemic cells present in the peripheral blood. (auth)

20530 THE EFFECT OF EXPERIMENTAL RACHITISM ON THE FIXATION OF RADIOSTRONTIUM IN THE SKELETON. (a) STUDY ON RATS AFFECTED WITH RICKETS IN THE EVOLUTION PHASE. Ugo Meldolesi and Salvatore Privitera (Università, Catania, Italy and Centro Siciliano de Fisica Nucleare, Italy). Radiobiol. latina, 3: 253-62 (July-Sept. 1960). (In Italian)

The fixation of Sr^{89} in the skeleton of the rachitic rat during the evolution of the malady was studied. After studying the total activity of bone, which appeared reduced in rachitic animals by comparison with controls, the activity per unit weight of dried and calcined material was calculated. The results appeared to be almost identical in two groups of animals at different stages in the evolution of the malady. Finally, the activity per unit volume of bone was established in order to estimate irradiation damage to the bone marrow independently of the size of the skeleton. Rachitic animals in more advanced stages of the malady presented a higher activity per cc than the controls. (auth)

20531 ESTIMATION OF TOTAL BODY FAT FROM POTASSIUM-40 CONTENT. Ernest C. Anderson and Wright H. Langham (Los Alamos Scientific Lab., N. Mex.). Science, 133: 1917(June 16, 1961).

A brief review is given of the development of methods for the determination of total body potassium by whole-body scintillation counting and of studies to establish the utility of body potassium as a measure of gross body composition including fat. (auth)

20532 STRUCTURAL MODIFICATIONS INDUCED IN THE SKELETAL TISSUE BY A Sr RICH DIET. L. Tessari and G. M. Spina (Università, Milan). Sperimentale, 111: 27-35(Jan.-Feb. 1961). (In Italian).

The structural modifications induced on the cartilaginous and bony tissues in the rat by a diet rich in Sr were studied with radiographic and histologic methods. It was observed that the presence of Sr in the bone mineral blocks the remodeling process of the newly formed trabeculae thus giving a characteristic aspect to the epiphyseo-metaphyseal tract of long bones. (auth)

20533 TOXICITY OF INDUSTRIAL METALS. Ethel Browning. London, Butterworths, 1961. 344p. 50/-.

A survey of the main features of the occurrence, preparation, physical and chemical properties, metabolism, and toxicology of the principal metals encountered in modern industry is presented. Special attention is devoted to the metabolic features: first, from the point of view that a knowledge of their paths of absorption, excretion, and distribution within the body may indicate how and where their potential toxic effects are likely to be exerted and therefore in some measure how these effects can be prevented; second, with a view of them in radioactive form from nuclear fall-out. The radioactive aspect is not examined in detail, except where experiments with labeled metals are carried out to elucidate their metabolic behavior. (N.W.R.)

20534 RADIOCHEMICAL PROCEDURES. G. E. Harrison and W. H. A. Raymond. p.54-9 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Procedures are described for the radiometric analysis of tissue samples for total radioactivity and isotopes of I, Ru, Mo, Te, Ba, Sr, and an insoluble hydroxide fraction which includes the rare earth nuclides. (C.H.)

20535 THE METABOLISM IN DAIRY COWS OF FISSION PRODUCTS. Helen M. Squire (Agricultural Research Council Field Station, Compton, Berks, Eng.), L. J. Middleton, B. F. Sansom, and R. C. Coid. p.69-90 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Mixed fission products obtained from Operation Buffalo were fed to lactating dairy cows. Milk, urine, and feces were collected and assayed for total radioactivity. Chemical analyses showed that the major part of the activity in the milk and urine was due to the isotopes of iodine. Ba^{140}, Sr^{89}, and Te^{132}, were the other important radioactive nuclides. These results were compared with the results of similar experiments in which chemically separated I^{131} and Sr^{89} were fed to cows. There was a wide variation in the amount of I^{131} and Sr^{89} secreted in the milk; part of this variation was due to differences in the milk yields. There was, however, no detectable difference in the metabolism of the nuclides obtained from pile fission products or after nuclear explosions. (auth)

20536 DISTRIBUTION OF FISSION PRODUCTS IN ANIMALS AT MARALINGA. D. W. H. Barnes (Medical Research Council Radiobiological Research Unit., Harwell, Berks, Eng.) and W. J. H. Butterfield. p.91-115 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Results are reported from studies on the uptake and tissue distribution of fission products in sheep and rabbits. The passage of radioactivity along the gut was slower in sheep than in rabbits due to delay in the rumen. Sheep and rabbits fed the fluid extract of fission products behaved in a similar fashion. The lining of the gastrointestinal tract was found to be exposed to relatively high levels of radioactivity from the ingestion of fresh fission products. (C.H.)

20537 RADIOACTIVE ISOTOPES IN ANIMAL THYROIDS. P. Dunn (Dept. of Supply, Australia). p.116-25 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

By means of a recording single channel γ spectrometer the following isotopes were identified in the thyroid of sheep fed on fission products from a nuclear explosion: I^{131}, I^{133}, Xe^{133}, and Xe^{135}. In one case Te^{132} was identified; this confirms the presence of I^{132}. During the period up to F + 96 hr short-lived isotopes of xenon and iodine contribute largely to the total activity in the thyroid. After F + 96 hr the activity ratio of I^{131} was similar to that calculated by Dale. It was shown that the radiation dose to the thyroid due to the isotopes of xenon would be insignificant com-

pared to the dose due to I^{131} and I^{133}. The activities of the isotopes of iodine and xenon in the thyroid at the time of sacrifice were assessed from the γ spectrograms and the activity ratio $I^{131} + I^{133}$ to I^{131} compared with the theoretically predicted figure of Dale. Comparisons were made of the relative efficiency of detection of I^{131} activity in the thyroid using scintillation and M6 liquid counters. The well-type γ scintillator set on a narrow channel to measure the maximum of the main γ-energy peak was considerably more efficient. (auth)

20538 THE DISTRIBUTION OF RADIOACTIVITY IN RABBITS FOLLOWING INGESTION OF FISSION PRODUCTS COLLECTED FROM THE CLOUD FROM A MEGATON WEAPON. F. M. Bishop, T. E. F. Carr, G. E. Harrison, A. Sutton, and J. Wall (Medical Research Council Radiobiological Research Unit., Harwell, Berks, Eng.). p.136-44 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

The uptake in rabbits was studied following ingestion of fission-product material obtained by aerial collection from the cloud from a megaton weapon. Six Dutch rabbits were used, two fed a single dose of about 1.5 mc and the remainder seven daily doses totalling about 2 mc at the time of the first dose. The absorption and retention of activity were compared with those in similar rabbits given fission-product material collected at the Maralinga trials. While no appreciable difference was observed in the identity of the fission products deposited in the rabbits, it was shown that the greater water solubility of the radioactive material collected from the megaton weapon was accompanied by a rather higher absorption and retention in the animals. (auth)

20539 THE METABOLISM BY A DAIRY COW OF FISSION PRODUCTS OBTAINED FROM OPERATION GRAPPLE. Helen M. Squire (Agricultural Research Council Field Station, Compton, Newbury, Berks, Eng.), B. F. Sansom, and L. J. Middleton. p.145-51 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

The metabolic effects in dairy cows of fission products resulting from a tower shot and an air burst were compared with the effects of material collected after a megaton air burst. Data are tabulated on the distribution of I^{131}, Sr^{89}, and Ba^{140} in diet, milk, and tissues. (C.H.)

20540 RADIOACTIVE CALCIUM (Ca^{47}) TRACER STUDIES IN PATIENTS WITH BONE LESIONS. E. Greenberg, A. Pazianos, K. R. Corey, P. Kenny, J. S. Laughlin, and O. H. Pearson (Sloan-Kettering Inst. for Cancer Research, Memorial Center for Cancer and Allied Diseases, New York). p.158-69 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Calcium^{47}, a newly available radioactive isotope, is an ideal tracer for calcium kinetic studies and for local uptake measurements over the skeleton by external counting. Preliminary results of Ca^{47} tracer studies in patients with malignant lesions of bone are presented. The results indicate that progressive bone lesions are usually associated with an increased accretion rate of calcium in the skeleton as a whole and an increased local uptake of calcium in the lesion areas. These observations suggest that bone-seeking isotopes may be useful both in the diagnosis of bone lesions and for internal radiation therapy of malignant bone lesions. (auth)

20541 CURRENT STATUS OF CURIUM INHALATION EXPOSURES IN HUMANS. H. G. Parker, M. D. Thaxter, and M. W. Biggs (Univ. of California, Berkeley and Livermore). p.147-50 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

The maximum permissible amount of alpha-emitting curium in the human body ranges from one-hundredth to one millimicrogram. Inhalation presents the greatest occupational risk. Since curium has but recently become available in quantities approaching a gram, its metabolism is known almost solely by analogy with plutonium and closely related elements. An incident is described concerning a curium accelerator target aerosolized by explosion. Management of the spill, sampling, particle sizing, and medical findings are presented. Seven of the 27 persons present showed low levels of curium excretion. The data from this incident are compared with that from three other inhalation exposures to curium compounds at this laboratory. (auth)

20542 BERYLLIUM DISEASE IN BRITAIN, WITH PARTICULAR REFERENCE TO AN INVESTIGATION IN A NONFERROUS FOUNDRY. G. Kazantzis. p.290-8 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Data are summarized on 16 cases of beryllium disease which occurred in Great Britain since 1948. The occupational history, clinical findings, and subsequent fate of the victims are tabulated. Two cases were employees of a factory making nonferrous alloys, including Be-Cu. Results are included from a survey on other workers of this factory. (C.H.)

20543 RESPIRATORY DISEASE ASSOCIATED WITH BERYLLIUM REFINING AND ALLOY FABRICATION. Franz N. Metzner and Jan Lieben. p.316-19 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

An extensive medical epidemiologic and air pollution study was conducted in the area of a Pennsylvania beryllium plant. The objective was to obtain information as to the extent and cause of occupational and nonoccupational pulmonary beryllium disease in the area, and to develop medical and engineering control measures that would prevent the occurrence of beryllium disease. Findings are summarized on a total of 58 cases of chronic respiratory tract beryllium disease. Modifications in air cleaning equipment are expected to reduce in-plant and neighborhood beryllium contamination to safe levels. (C.H.)

20544 TREATMENT OF PLUTONIUM DEPOSITION IN HUMANS WITH DTPA—EFFECTIVENESS OF LONG-TERM ADMINISTRATION AND ORAL ADMINISTRATION. W. Daggett Norwood (General Electric Co., Richland, Wash.). p.335-8 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Treatment of five employees who had harbored small quantities of Pu^{239} for some years indicated that intravenously administered diethylenetriaminepentaacetic acid (DTPA) was much the most effective agent discovered for increasing the urinary elimination of Pu^{239}. Results are reported from a study of the comparative effect of DTPA upon excretion of Pu^{239} when given orally and when given intravenously. The effect of the long-term administration of DTPA was also studied. (C.H.)

20545 BASIC PHYSIOLOGIC MECHANISMS IN THE PULMONARY RESPONSE TO INHALED PARTICULATES. Charles W. LaBelle and Heinrich Brieger (Jefferson Medical Coll., Philadelphia). p.730-5 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Since the number of particles cleared is proportional to the number of phagocytes present in the lung, and since the rate at which particles leave the lung is identical with the rate at which phagocytes disappear from the lung, it seems a reasonable conclusion that the particles and the phagocytes leave the lung together. Since the number of motile cells counted by new technique proves to be considerably larger than the total number of fixed phagocytic cells counted in histologic preparations, it seems reasonable to conclude that the primary function of these cells is not, as was formerly believed, the absorption of particles into the lung tissue, but rather that they constitute a defense mechanism whose function is the transport of noxious particles from highly vulnerable alveoli to the gastrointestinal tract, where in fact most of these particles prove to be relatively harmless. (auth)

20546 STUDIES ON CALCIUM AND STRONTIUM-90 METABOLISM IN RATS. I. STUDIES ON DIGESTIVE JUICES CALCIUM. II. LONG TERM EXPERIMENTS ON STRONTIUM-90 METABOLISM. III. THE ACCRETION AND RESORPTION OF CALCIUM IN THE SKELETON. Fredrik C. Gran. Norwegian Monographs on Medical Science. Oslo, Oslo University Press, 1960. 109p.

A method is described for determining Ca in digestive juice, based on the continuous ingestion of Ca^{45} with stable Ca in the food. The true absorption of Ca was estimated from results. Long-term balance experiments were carried out to study the accumulation of Sr^{90} in rats with a constant level of Sr^{90} in their diet and with 0.25% Ca. Data are tabulated. Results are also reported from studies on the dynamics of Ca accretion and resorption in the skeleton. (C.H.)

Fallout and Ecology

20547 FISSION-PRODUCT AND CERIUM UPTAKE BY BACTERIA, YEASTS, AND MOLDS. G. T. Johnson and G. C. Kyker (Univ. of Arkansas, Fayetteville and Oak Ridge Inst. of Nuclear Studies, Tenn.). J. Bacteriol., 81: 733-40 (May 1961).

The uptakes of Ce and of gross fission products by 12 bacteria (including 4 Streptomyces sp.), 4 yeasts, and 9 molds were studied under pure culture conditions. Significant uptakes were observed in all cases in which adequate growth was obtained. With few exceptions the uptake of Ce was considerably higher than that of fission products. These findings suggest ecological significance for the lanthanide components of fission products. (auth)

20548 EFFECTS OF PLANT NUTRIENTS ON UPTAKE OF RADIOSTRONTIUM BY THATCHER WHEAT. C. C. Lee (Univ. of Saskatchewan, Saskatoon). Science, 133: 1921-2(June 16, 1961).

The effects of various dosages of ammonium dihydrogen phosphate, monocalcium phosphate, calcium chloride, and potassium chloride on the uptake of radiostrontium by Thatcher wheat grown in Saskatchewan Oxbow loam soil containing strontium-85 were studied. Monocalcium phosphate at a dose level of about 600 lb/acre of soil effected a statistically significant reduction of strontium-85 uptake in each of the four plant fractions of grain, chaff, stem, and leaf. At the very reasonable dosage of about 60 lb/acre, monocalcium phosphate gave a statistically significant reduction in strontium-85 uptake in the grain and chaff. (auth)

20549 BIOLOGICAL SCIENCES. VOLUME 3. THE ENTRY OF FISSION PRODUCTS INTO FOOD CHAINS. J. F. Loutit and R. Scott Russell, eds. Progress in Nuclear Energy. Series VI. New York, Pergamon Press, 1961. 173p. $7.00.

Results are reported from studies performed in connection with Operation Buffalo. Separate abstracts have been prepared for each of the 11 sections. (C.H.)

20550 PHYSICAL CHARACTERISTICS OF FALLOUT AND ITS RETENTION ON HERBAGE. R. Scott Russell (Agricultural Research Council Radiobiological Lab., Letcombe Regis, Berks, Eng.) and J. V. Possingham. p.2-26 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Procedures used in collecting fall-out samples in the field and in sampling herbage are described. The solubility of fall-out samples and the retention of fall-out on herbage were tested and the ratio of Sr^{89} to total fall-out was measured. It was concluded that the variation in the extent to which herbage retains fall-out makes the sampling of contaminated pastures impractical under emergency conditions. It is suggested that since the major hazard is likely to be due to the transfer of I^{131} or Sr^{89} to milk the sampling of milk would be a more satisfactory method of monitoring. The sampling of dung for Sr^{89} would also provide reliable information. (C.H.)

20551 THE RETENTION OF FALLOUT ON CEREALS RIPE FOR HARVEST. L. J. Middleton (Agricultural Research Council Field Station, Compton, Berks, Eng.), R. Scott Russell, and E. N. Greer. p.27-34 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

An investigation was made of the hazards resulting from the consumption of flour prepared from wheat standing ripe for harvest at the time of the detonation of an atomic weapon. The relationship between the deposition of fallout per unit area of ground surface and the degree of contamination of cereal grain and of resultant flour was examined. Since a significant interval of time normally elapses between the harvesting of grain and the consumption of flour, emphasis was placed on longer-lived fission products. Data are tabulated on Sr^{89} and Sr^{90} contents of grain from areas with a known dose-rate from fall-out and the $Sr^{89}-Sr^{90}$ content of flour from these grains. It is concluded that the hazards from the consumption of contaminated flour is smaller by a factor of more than a thousand than the hazards from the consumption of contaminated milk. (C.H.)

20552 THE DISTRIBUTION OF RADIOACTIVITY IN RABBITS FOLLOWING INGESTION OF FISSION PRODUCTS COLLECTED FROM ATOMIC WEAPON CLOUDS. T. E. F. Carr, G. E. Harrison, and A. Sutton (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). p.35-53 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Incorporation into the diet given to young Dutch rabbits of an aerial collection of fission products showed that the iodine activities as well as those due to Sr^{89}, $Ba^{140}-La^{140}$, $Te^{132}-I^{132}$ and $Mo^{99}-Tc^{99}$ were well absorbed from the alimentary canal. It was shown that the absorption of these

fission products produced in the weapon clouds is approximately equal to that from liquid doses of the separated pile-fission products. On the other hand, radiochemical analysis showed that radioruthenium and fission products of the rare earths are very slightly absorbed and that they only present a radioactive hazard in so far as they contribute to the general irradiation of the intestinal mucosa. It is inferred from the present experiments that the pattern of absorption and retention in the rabbit of the fission material from the weapon clouds would be similar to that from a liquid dose of carrier-free fission products from a reactor. (auth)

20553 CALCULATION OF THE DOSE TO THE INTESTINAL TRACT, THYROID AND SKELETON WHEN MIXED FISSION PRODUCTS ARE FED TO A RABBIT. G. E. Harrison. p.60-8 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

The radiation dose to the intestinal tract, thyroid, and skeleton following the ingestion of mixed fission products was calculated for rabbits. It was shown that 80 to 90% of the dose is unabsorbed and is excreted in the feces. Iodine showed a high degree of absorption from the alimentary canal. Activity in the skeleton was almost entirely due to Sr^{89} and Ba^{140}. The assumptions made in order to calculate the radiation dose are summarized. (C.H.)

20554 GENERAL CONCLUSIONS. J. F. Loutit (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.) and R. Scott Russell. p.126-35 of "Biological Sciences. Volume 3." J. F. Loutit and R. Scott Russell, eds. New York, Pergamon Press, 1961.

Hazards from the incorporation of fall-out into the food chain are reviewed. Results of a series of studies conducted during Operation Buffalo led to the conclusion that fission products other than the isotopes of I and Sr are of relatively small importance, and that the metabolism of these substances from fall-out can be validly inferred from the results of experiments with chemically separated fission products. (C.H.)

Radiation Effects on Living Tissues

20555 (OOR-291,33) MICROWAVE AND RADIOFREQUENCY SPECTROSCOPY. Technical Report No. 33, May 1, 1960—August 1, 1960. Walter Gordy (Duke Univ., Durham, N. C. Microwave Lab.). Contract DA-36-034-ORD-1233. 55p.

Two separate technical reports are presented. From the first observation of electron spin resonance of irradiated proteins in 1955 it was clear that the electron vacancy, or electron spin density, caused by the irradiation must be able to migrate through the protein from the multiple sites where the ionizing particles, or quanta, strike to the few sites such as the cystine sulfur where the spin density is finally detected. These original observations were carried out at room temperature. In the present work it is shown that such migrations do not, in fact, occur significantly at the temperature of liquid nitrogen, 77°K. Thus the migration of electron holes in the valence shell of proteins requires an activation energy, assistance from the molecular motions of excited vibrational or tortional oxcillational states. Electron spin resonance absorption of an irradiated single crystal of N-acetylglycine was observed at room temperature at 9 kMc/sec and 23 kMc/sec. From the analysis of the anisotropy in the spectroscopic splitting factor and in the nuclear hyperfine interaction constant, a chemical structure is deduced for the free radical. The C-H bond is in the NCC plane and approximately along the bisector of the NCC angle. The unpaired electron spin density is essentially in a π-orbital, about 72 per cent of which is the p orbital of the CH carbon directed perpendicular to the NCC plane. (auth)

20556 ERYTHROCYTE LIFE SPAN IN NORMAL MICE AND IN RADIATION BONE MARROW CHIMERAS. Joan Wright Goodman and L. H. Smith (Oak Ridge National Lab., Tenn.). Am. J. Physiol., 200: 764-70(Apr. 1961).

Average potential erythrocyte life spans measured by disappearance rates of transfused, isologous Cr^{51}-labeled cells in mice of several inbred strains and F_1 hybrids varied from 50 to 55 days and the Cr^{51} half time from 15 to 20 days. Sprague-Dawley rats had a potential red cell life span of 60 days and an apparent half time of 19 days. Normal life spans for isologous and homologous erythrocytes were measured both early and late after irradiation in isologous bone marrow chimeras. Homologous chimeras, early after irradiation and bone marrow transplantation, exhibited severe anemia and rapid rate of depletion of host-type erythrocytes. In contrast, after 2 or more months of chimerism, life spans of both host- and donor-type erythrocytes were normal. Mice with rat marrow transplants functional for at least 2 months never cleared rat red cells rapidly. Sudden and very rapid disappearance of mouse erythrocytes was seen from many, but not all, such chimeras. Erythrocytes from normal rats were depleted more rapidly in chimeras than in normal rats, the potential life span being shortened by about 10 days. Mouse-grown (chimeric) rat erythrocytes were depleted in heterologous chimeras at a rate identical to that of chimeric cells in normal rats and of normal rat cells in chimeras. (auth)

20557 SOME CONSEQUENCES OF PULMONARY IRRADIATION. George Cooper, Jr., John L. Guerrant, A. Gardner Harden, and David Teates (Univ. of Virginia School of Medicine, Charlottesville). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 865-74(May 1961).

The degenerative and fibrotic changes produced by irradiation in all tissues are of especial significance when their presence interferes with vital functions. One of those in which this happens is pulmonary tissue, irradiation injury of which impairs the ventilatory and diffusion capacities of the lung. Because the enormous reserve capacity of the lungs provides a good margin of safety, when care is taken to minimize incidental pulmonary irradiation, and when the lungs are normal or had been normal before a primary pulmonary malignancy developed, the doses of radiation usually recommended can probably be given with sequelae of acceptable frequency and severity. The short term effects have been fairly well documented; the long term effects have not. When the pulmonary reserve has been lowered by pre-existing abnormality, less radiation injury can be tolerated. Serial physiologic testing increases the accuracy with which radiation effect can be evaluated. There is some hope that it may be helpful in treatment planning and guidance. (auth)

20558 CHRONIC MYELOGENOUS LEUKEMIA FOLLOWING I^{131} THERAPY FOR METASTATIC THYROID CARCINOMA. Report of a Case and Some Considerations of the Etiologic Factors. Ahsen Ozarda, Umit Ergin, and Merrill A. Bender (Rosswell Park Memorial Inst., Buffalo). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 914-18(May 1961).

A case of chronic myelogenous leukemia was observed following I^{131} therapy. There has been no previous report of such a case, although acute and subacute leukemia have been reported. The literature has been reviewed and some tentative relationships have been considered between ionizing radiations, particularly from I^{131} therapy, and the incidence of leukemia. No definite statement can be made since other etiologic factors cannot be definitely ruled out and the number of reported cases is too small to draw any conclusion. Nevertheless, large doses of I^{131} appear to be hazardous and may be leukemogenic. (auth)

20559 LEUKEMOGENIC AND CANCEROGENIC EFFECTS OF RADIATION. T. Leucutia (Harper Hospital, Detroit). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 989-92(May 1961).

Data are reviewed from long-range observations on the leukemogenic and cancerogenic effects of radiation. It is concluded that leukemogenic and carcinogenic effects result from large doses of ionizing radiations. Such effects were not demonstrated in conjunction with exposure to low doses. (C.H.)

20560 LESIONS OF THE SMALL INTESTINE SECONDARY TO IRRADIATION. A. Devois, J. Baudon, D. Chevallier (Hopital Tenon, Paris). Ann. radiol., 4, Nos. 3-4, 185-197(1961). (In French)

Lesions of the small intestine secondary to irradiation are relatively rare, but must be considered, however, when a patient who has received pelvic irradiation for a genital cancer develops intestinal complaints resistant to symptomatic medical treatment, or presents an acute episode such as obstruction, peritonitis, hemorrhage or fistula formation. The part played by the various etiological factors is difficult to establish. The gross changes are rather uniform. The diagnosis of lesions of the small intestine is easy; the clinical features which can appear after a certain latent period but rarely after two or three years, speak for themselves. Radiography, principally small intestine follow-through, has great value in diagnosing these lesions and must be repeated if necessary to study the progress in a suspicious area. The main problem is to exclude malignant change. Surgery will serve to confirm the diagnosis and constitute the treatment of choice for these small intestinal lesions. (auth)

20561 THE WEIGHT RESPONSE OF RATS EXPOSED TO FRACTIONATED DOSAGES OF 400 KV X-RAYS AND 20-22 MeV BETATRON X-RAYS AND ELECTRONS. W. S. Moos, J. B. Fuller, and R. A. Harvey (Univ. of Illinois, Coll. of Medicine, Chicago). Atompraxis, 7: 184-6(May 1961). (In English)

The influence of fractionated dosages of various types of ionizing radiation (400 kv, 20 Mev x rays and 20 Mev electrons) was studied on the weight response of rats. The daily dosages ranged from 50 to 250 r per experimental group. The same rate of weight decrease comparing animals radiated with 150 r/day (400 kv, x rays) to 250 r/day (20 Mev, x rays or electrons) indicates that the difference between these different radiations is only quantitative. This finding compares well with mortality studies. (auth)

20562 THE EFFECT OF PROLONGED DAILY IRRADIATION OF NUCLEIC ACID TURNOVER IN SOME TISSUES OF THE RABBIT. R. E. Libinzon and V. V. Konstantinova. Biochemistry (U.S.S.R.) (English Translation), 25: 796-801 (May-June 1961).

The effect of prolonged irradiation with 30 r per day on the nucleic acids of rabbits' liver and bone marrow was studied. The fractionation of the irradiation dose over a prolonged period was found to decrease the biological effect. In the liver the mean RNA and DNA phosphorus content per cell did not vary appreciably; in the bone marrow a considerable fall in nucleic acid concentration was observed almost throughout the entire experimental period. The mean DNA-P content per cell was markedly increased both in the liver and in bone marrow. In liver at cumulative doses of 420 and 2490 r, the rate of P^{32} incorporation into DNA was increased 2.2 and 2.7 times, respectively. The specific activity (SA) of the DNA was definitely depressed at cumulative doses ranging from 900 to 1920 r. Changes in the SA of the RNA-P, although not so pronounced, were in the same direction as those in DNA. The specific activities of both the RNA-P and DNA-P in bone marrow were somewhat below control values at the 210 r dose level, and considerably elevated at dose levels 420, 630 and 2490 r. A theory was advanced about the mechanism of increased rates of DNA synthesis and the changes in mitotic activity following chronic irradiation. It is believed that such a reaction to chronic irradiation confers upon the cells an increased resistance to radiation. (auth)

20563 LOCALIZATION OF β-GALACTOSIDASE IN CELLS OF ESCHERICHIA COLI BY LOW VOLTAGE ELECTRON BOMBARDMENT. John W. Preiss and Ernest Pollard (Yale Univ., New Haven). Biophys. J., 1: 429-35(May 1961).

By using low voltage electrons to bombard dried cells of Escherichia coli, the inactivation of the enzyme β-galactosidase as a function of depth of electron penetration was studied. There is little inactivation for a penetration of 100 A, but considerable for a penetration of 300 A. An analysis of the data for six initial electron energies shows that there exist outer and inner bounds of the enzyme region which are approximately 300 and 700 A below the cell surface, respectively. (auth)

20564 CHANGE IN THE SURFACE PROPERTIES OF IRRADIATED DEOXYRIBONUCLEOPROTEIN AND DEOXYRIBONUCLEIC ACID. A. M. Tongur and A. G. Pasynskii (Bakh Inst. of Biochemistry, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 587-93(1960).

DNA monolayers (by the method of spreading of solid grains) and those of DNP (by the method of spreading solutions) were obtained on a 38% aqueous solution of $(NH_4)_2SO_4$. It was shown that the thickness of the monolayers formed for preparations of different molecular weights is 20 to 23 A which corresponds to the horizontal arrangement of the molecules in the monolayer. The pressure-area curves of the monolayers obtained from native preparations and those destroyed by x rays (doses of 10^4 to 10^6 r) quite closely agree with each other which is indicative of uniform density of filling of the monolayer with the zigzags of the polynucleotide chain or the large fragments of this chain for a given lateral pressure. (auth)

20565 ANALYSIS OF THE EFFECT OF THE CHIEF PHYSICAL FACTORS CHANGING RADIOSENSITIVITY. L. Kh. Eidus and E. (Ye) E. Ganassi (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 594-604(1960).

Comparison of the results of experiments on irradiation of biological objects in vivo and in vitro with the data obtained by the electron paramagnetic resonance method leads to the conclusion that, on irradiation, unpaired electrons subject to the action of a number of agents are formed in macromolecules and in biological objects and may be maintained for a long time. The subsequent fate of these unpaired electrons varies. A part of them vanish in the presence of sufficient moisture without producing damage.

The protective role of water is connected with this. The effect of oxygen on the second part produces damage, which only comes about in the presence of water. Damage by heat is associated with the action on the third part of the unpaired electrons and this damage is also only possible in the presence of water. The protective role of heat observed in a number of experiments is due to change in the ratio of the effects of the various agents modifying damage. The fact that the damaging effect of all three agents considered, heat, oxygen, and nitric oxide, comes about only with the participation of water is worthy of attention. In experiments with protein solutions disappearance of unpaired electrons under the influence of the modifying agents was accompanied by irreversible loss of enzymatic activity. Since in the general case the region of localization of unpaired electrons apparently is away from the enzymatic centers, these processes must incorporate migration of the charge and energy. The presence of water turns out to be just as necessary for this as is the effect of the modifying agents themselves. (auth)

20566 CHANGE IN RADIOSENSITIVITY OF ERYTHROCYTES. A. M. Kuzin and K. S. Trincher (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 605-11(1960).

A method was evolved for detecting radiation damage to red cells suspended in saline for a dose of 500 r of γ rays. The protein molecules of the blood plasma exert a protective effect against penetrating radiations on the structural protein complexes of the surface layer of the red cell. This protective action was detected at doses up to 3×10^3 r. A hypothesis is advanced on the radical mechanism of radiation damage to the cell at limiting low doses of penetrating radiations. (auth)

20567 CHANGE IN THE PROPERTIES OF ERYTHROCYTES WHEN EXPOSED TO SUB-HAEMOLYTIC DOSES OF GAMMA-RADIATION. Yu. A. Kriger and I. M. Parkhomenko (Lomonosov State Univ., Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 611-15(1960).

Based on the findings presented, it is concluded that radiation damage to erythrocytes is the result of an irradiation-chemical process weakening the link between the structural components of the stroma of the red blood corpuscles. (auth)

20568 REMOTE EFFECT OF RADIATION ON MOUSE TESTES. M. D. Pomerantseva (Inst. of Genetics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 616-18(1960).

A comparison was made of the degree of damage to rat testes following local and whole-body x irradiation. The criteria of the degree of damage to the testes were changes in weight and histological structure. No difference in the degree of damage was found. (C.H.)

20569 FORMATION OF ORGANIC PEROXIDES IN THE LIVER OF RATS IRRADIATED WITH IONIZING RAYS. V. Mal'ts (Lomonosov State Univ., Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 619-25(1960).

After whole-body single dose ionizing irradiation of rats, accumulation of peroxides of lipids is detected in the liver. After a dose of 200 r the amount of peroxides after a brief increase begins to return to normal, at doses of 800 and 10000 r there is a substantial rise in the peroxide content. After irradiation with a dose of 10000 r two peaks are found in the curve of peroxide accumulation. The reaction has the character of a branched chain reaction. (auth)

20570 INVESTIGATION OF THE ELECTRICAL CONDUCTIVITY AND AUTOLYSIS OF THE HEPATIC TISSUE OF IRRADIATED ANIMALS. E. (Ye) V. Burlakova and I. M. Parkhomenko (Lomonosov State Univ., Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 625-32 (1960).

A study was made of change in the value of low-frequency and high-frequency resistance and dispersion of resistance of the liver of white rats irradiated in vitro with radioactive cobalt γ rays and also the changes in the values of resistance and processes of autolysis of the surviving hepatic tissue of white mice irradiated during life with cobalt γ rays. It was established that on irradiation of the surviving hepatic tissue at doses of 40000 and 50000 r an increase occurs in the dispersion of electrical resistance and the value of the low-frequency and high-frequency resistances. Intensification of autolytic processes in the surviving hepatic tissue irradiated at doses of 800 to 1000 r was detected. A direct correlation was established between intensification of the autolytic processes of surviving hepatic tissue of irradiated mice and an increase in the value of its low-frequency resistance. The value of the correlation coefficient of these two processes was equal for the 1st hour to 0.88, for the 2nd 0.86, and for the 3rd 0.81. (auth)

20571 DETECTION OF PHYSIOLOGICAL PROTECTION AGAINST IONIZING RADIATIONS IN THE AUTOTETRAPLOIDS OF SEED BUCKWHEAT. V. V. Sakharov, V. V. Mansurova, R. N. Platonova, and V. K. Shcherbakov (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 632-41 (1960).

Cytological analysis of the seedlings of buckwheat from irradiated seed demonstrated the radioresistance of polyploid plants. The effects of treatment of seed with colchicine and reaction mechanisms involved in the effects of ploidy on radioresistance are discussed. (C.H.)

20572 RELATION BETWEEN DOSE RATE AND THE RADIOBIOLOGICAL EFFECT IN PLANTS. A. M. Kuzin, N. M. Berezina, and O. N. Shlykova (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 642-6(1960).

Dried maize seeds were irradiated at various dose rates. The effects of radiation were determined by measuring roots and leaves of seedlings and by measuring dry weight. Data are tabulated. Results indicate that prolonged irradiation exerted a distinctly greater depressant effect than did short periods of irradiation, especially in the early stages of germination. (C.H.)

20573 INTENSIFICATION OF EFFECT OF X-IRRADIATION ON SEEDS DURING STORAGE. I. M. Vasil'ev, B. G. Zhukov, and T. S. Spasskaia (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 646-9(1960).

Irradiation of seeds with 1000 r had no effect on plants grown from freshly-irradiated seeds and had only a slight effect on plants grown from seeds stored after irradiation. Irradiation with doses of 5000 r suppressed the growth of plants from freshly irradiated seeds while the depressant effect on plants grown from seeds stored after irradiation was even greater. (C.H.)

20574 IN VITRO EFFECTS OF X-RADIATION ON WHITE BLOOD CELLS AND BLOOD PLATELETS. Richard Wagner, Norma Meyerriecks, and Carroll Z. Berman (Boston Floating Hospital; Tufts Univ., Boston; and Boston Dispensary). Blood, 12: 733-45(Aug. 1957).

Alkaline phosphatase activity of leukocytes is enhanced by radiation with 50000 r. This disturbance accentuates the inherent aging process of white blood cells and may be explained by changes in the cell envelope. X radiation dimin-

ishes the endogenous oxygen uptake of leukocyte-platelet suspensions by approximately 20%. This response to radiation is demonstrable at exposures of as little as 5000 r. The decreasing effect is diminished when substrates such as sodium succinate or α-glycerophosphate are added, within a wide range of their concentration. With increasing substrate concentration the decrease due to radiation approaches that of the endogenous respiration and even exceeds it in some of the experiments. In pure blood platelets a similar decreasing x radiation effect occurs for endogenous respiration as well as succinic dehydrogenase activity; α-glycerophosphate dehydrogenase activity, on the other hand is enhanced. The oxygen uptake in leukocyte-platelet suspensions due only to leukocytes can be calculated. While the percentage radiation decrease of pure leukocytes is unchanged for endogenous and succinate activity, the decrease for α-glycerophosphate as substrate reaches considerably higher levels (68% compared with 8.2% in leukocyte-platelet suspensions). Thus α-glycerophosphate dehydrogenase activity seems to be most sensitive to x radiation. It was shown in a previous study that α-glycerophosphate dehydrogenase is one of the most important respiratory enzymes in leukocytes. The glycolytic system in leukocytes remains intact following exposure to radiation with 50000 r. (auth)

20575 THE EFFECTS OF URANIUM AND THORIUM COMPOUNDS ON THE PRODUCTION OF PYOVERDINE BY PSEUDOMONAS. Yi-Kuan Chuang. Bull. Inst. Chem. Acad. Sinica, No. 3, 29-34(Nov. 1960). (In English)

Radioactive compounds such as uranyl nitrate or thorium nitrate are found to exert an inhibitory effect at higher concentration (above 0.1%) on the growth and pigment production of Pseudomonas reptilivora. (auth)

20576 EFFECT OF ULTRAVIOLET IRRADIATION ON THE GROWTH OF SPONDYLOCLADIUM AUSTRALE. Mingho Yu. Bull. Inst. Chem. Acad. Sinica, No. 3, 35-43 (Nov. 1960). (In English)

A study was made of the effect of ultraviolet irradiation on the growth of Spondylocladium australe, a kind of Fungi Imperfecti, grown on Czapek-glutamate agar. Several survival curves were drawn from the results obtained by varying the treatment conditions. It was observed that addition of peptone to the media improved the survival. Withdrawal of $NaNO_3$ from the medium also showed a better protection result at higher doses. Varying the concentration of sucrose in the media resulted in the phenomenon that higher sucrose-concentration favored the survival of the irradiated organism, while for the unirradiated cells lower concentration showed better growth. Pretreatment incubation enhanced to a great extent the damage caused by UV irradiation. Growth of the irradiated and unirradiated cells in liquid media was compared for their dried mycelial weight. Occurrence of amino acids in the liquid culture after growth was studied and the results were discussed. (auth)

20577 THE RADIOSENSITIVITY OF TWO SPECIES OF NICOTIANA AND OF THEIR INTERSPECIFIC HYBRID. Newton Meiselman, Arnold H. Sparrow, and James E. Gunckel (Brookhaven National Lab., Upton, N. Y.). Bull. Torrey Botan. Club, 88: No. 1, 33-8(Jan. 1961).

Two species of tobacco, Nicotiana bigelovii and N. glauca, and their hybrid were exposed to various dose rates of chronic gamma irradiation ranging from 37.5 to 375 r per day from cobalt-60 for periods up to 39 days. Within a species, chromosomal aberration frequency at a particular dose rate showed no significant increase in successive collections from 15 to 39 days of exposure. Differences in the amount of chromosomal aberration between stocks were evident for plants at the various dose rates as well as in the controls. Bridges and fragments were found to occur with a 38% frequency in the hybrid controls, but none were found in the control samples of the parental stocks. Under chronic irradiation, N. glauca was the least sensitive, N. bigelovii was next, and the hybrid was the most sensitive. Since the increase in radiation sensitivity of the hybrid cannot be explained on the basis of relative chromosome number, it is concluded that its increased radiosensitivity must be related to the inherent nature of its genetic instability or to its reduced growth rate. (auth)

20578 EFFECTS OF RADIATION ON EXFOLIATED NORMAL AND MALIGNANT ORAL CELLS. A Preliminary Study. Sol Silverman and Glenn E. Sheline (Univ. of California School of Medicine, San Francisco). Cancer, 14: 587-96(May-June 1961).

Serial cytological smears taken from both normal mucosa and oral carcinomas of 40 patients were studied for the presence of cancer cells and for radiation response (RR) of the normal-appearing cells. In 30 patients, the presence or absence of exfoliated cancer cells correlated with the clinical appraisal of the lesion. In 1, negative cytological findings were supported by examination of the surgical specimen even though clinically the lesion appeared active. Six patients with superficially healed lesions but palpable deeper masses showed no exfoliated malignant cells. Another patient had negative cytological findings and had a sloughing ulcerated lesion. Of 2 patients with positive cytological findings but clinically healed lesions, 1 developed obvious recurrence after 2.5 months. The other patient died after 6 months without evidence of recurrence. Of 17 patients in whom the cytological and clinical findings became negative and for whom follow-up data are available, there was definite clinical recurrence in 7; in 6, this was preceeded by reappearance of exfoliated cancer cells. Smears from the seventh patient remained negative. Observation of the disappearance and reappearance of exfoliated malignant cells appears to be a useful supplement to clinical examination. In assessing the lesion after therapy, it may provide evidence of recurrence not yet clinically apparent. In the present study, examination of individual cells showed no correlation between RR values or any specific cytological changes and either the radiation dose delivered or the clinical result of treatment. (auth)

20579 THE HISTOPATHOLOGIC STUDY OF THE DEVELOPMENT OF THE IRRADIATION-INDUCED LEUKEMIA IN C57BL MICE AND OF ITS INHIBITION BY TESTOSTERONE. Prawase Wasi, and Matthew Block (Univ. of Colorado, Denver). Cancer Research, 21: 463-73(May 1961).

It is probable that the coexistence of two factors is necessary for the development of leukemia in the C57BL mouse exposed to total-body irradiation. The first factor is destruction, followed by regeneration, of thymic lymphocytes. The second factor is the postirradiation environment which provides circumstances such that the regeneration of the thymic lymphocytes becomes uncontrolled, leading to the development of leukemia. Testosterone, by inhibiting the regeneration of thymic lymphocytes after radiation injury, removes one of the two essential factors, thereby reducing the incidence of leukemia in irradiated C57BL mice. (auth)

20580 EFFECT OF COLCHICINE AND X-RADIATION ON THE DIFFERENTIATION OF HUMAN EMBRYONAL CARCINOMA. A. Rees Midgley, Jr., and G. Barry Pierce, Jr. (Univ. of Pittsburgh). Cancer Research, 21: 545-9 (May 1961).

Treatment with colchicine or x radiation of human embryonal carcinoma of testicular origin, which has secreted a chorionic gonadotropin-like hormone in 20% of heterografted hosts, resulted in a 2 to 3 times increase in the incidence of chorionic gonadotropin-secreting tumors as determined in oophorectomized and hypophysectomized animals. Lines developed from three of the tumors treated with colchicine maintained a 50% incidence of gonadotropic secretion for several generations in the absence of further treatment. These lines gradually reverted to the normal 20% incidence of secretion during continued transplantation. This evidence has been interpreted as support for the contention that human embryonal carcinoma may be a stage in the development of choriocarcinoma. (auth)

20581 ON THE MECHANISM OF ACTION OF THE ALKYLATING AGENTS II. EFFECTS OF NITROGEN MUSTARD, MYLERAN, AND X-RADIATION ON NUCLEIC ACID BIOSYNTHESIS. Eberhard G. Trams, Moreshwar V. Nadkarni, and Paul K. Smith (George Washington Univ., Washington, D. C.). Cancer Research, 21: 567-70(May 1961).

The effects of nitrogen mustard, Myleran, and x radiation on the incorporation of isotopic orotic acid, aspartic acid, formaldehyde, adenine, and phosphate into the nucleic acids of the L1210 ascites leukemia are reported. The lack of uniformity in the incorporation pattern following pretreatment with each of the three drugs was considered significant. The treatments could result in stimulation as well as inhibition of precursor utilization. It was concluded that the alkylating agents attack numerous sites with varying degrees of specificity. (auth)

20582 CHROMATOGRAPHIC STUDY OF NINHYDRIN-POSITIVE SUBSTANCES IN ETIOLATED SHOOTS FROM CONTROL AND IRRADIATED MAIZE SEEDS. F. A. Haskins (Univ. of Nebraska, Lincoln). Crop Sci., 1: 219-21(May-June 1961).

Filter paper chromatography was used in a preliminary study of ninhydrin-positive substances (amino acids) in the juice of 6-day etiolated shoots and of the three major portions (first internode, coleoptile, and expanded foliage leaves) of such shoots from control and irradiated seeds of the maize hybrid Wf9 × Hy. Ninhydrin-positive substances were present at higher concentration in preparations of material grown from seeds treated with appropriate doses of x-rays or thermal neutrons than in control material. Although all preparations appeared qualitatively similar with respect to variety of ninhydrin-positive substances, the data on shoot length and weight clearly demonstrate the determinantal influence of the irradiation treatments on these attributes. These differences are due to the various ninhydrin-positive materials present and the dosages given. (N.W.R.)

20583 THE EFFECT OF THE γ-RAYS OF COBALT-60 ON THE INTESTINAL EPITHELIUM OF CHICKEN EMBRYOS IN TISSUE CULTURE. A. F. Ivanitskaya and Z. N. Faleeva (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 1456-9(Apr. 21, 1961). (In Russian)

Chicken embryos in fibroblast media exposed to γ-radiation of Co^{60} show a lowering and at higher doses a complete suppression of mitotic activity. For a detailed study, the growth of the epithelium was investigated, exposing the cultures to γ-radiation ranging from 100 to 200,000 r at the incubation temperature of 37.5 to 38°C. As a result of the radiation, especially at higher integrated doses, the growth of the epithelium was inhibited and the appearance of non-homogeneous growing tissue has been observed. Another effect of the high-level radiation consisted in the dilution of the medium and the breakdown of the integrity of the membrane's cells leading to the loss of their mobility. The behavior of the epithelium was found to be similar to that of intermuscular tissue. (TTT)

20584 THE OXYGEN EFFECT IN IRRADIATED MATURE AND MEIOTIC GERM CELLS OF DROSOPHILA MENANOGASTER. H. F. Hoenigsberg, E. Gallucci, and A. Giavelli (Università, Milan). Experientia, 17: 172-4 (1961). (In English)

Results are reported from a study on the radiosensitivity of spermatogenesis at different stages of development in Drosophila. It was found that oxygen increased the mutation rate while nitrogen protected against the effects of x radiation. (C.H.)

20585 ATTEMPT TO FORM A HETEROLOGOUS GUINEA FOWL-DOMESTIC FOWL RADIATION CHIMAREA. Marta Vojtiskova and Alena Lengerova (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague), 7: 87-92(1961). (In English)

An attempt was made to form a heterologous guinea fowl-domestic fowl radiation chimera. Young guinea fowls exposed to whole-body irradiation with doses of 830 to 1200 r were given a therapeutic dose of chicken embryonic spleen cells. The results showed that this treatment is ineffective, evidently because the mechanism of death is not the same in birds as in rodents, in which a similar therapeutic system proved very satisfactory. The temporary erythrocyte chimerism found in three guinea fowls exposed to sublethal irradiation did not affect their immunological reaction to the donor species. (auth)

20586 EFFECT OF SMALL DOSES OF CHLORAMPHENICOL IN DIMINISHING RADIATION DAMAGE TO THE CAPACITY OF ESCHERICHIA COLI B FOR PHAGE T 3. F. Hercik (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 7: 122-8(1961). (In English)

Short exposure of Escherichia coli B cells pre-irradiated with a dose of 80000 r to chloramphenicol increases their capacity for the formation of phage T 3 about sixfold as compared with cells irradiated with the same dose but not exposed to the action of the antibiotic. The increase in the colony forming ability of the irradiated cells is much greater. It can thus be assumed that cells producing phage originate from cells not damaged by radiation or by chloramphenicol, but also from cells in which radiation injury has been abolished by chloramphenicol. A large proportion of cells capable of division are unable to produce phage, indicating that the mechanisms responsible for division and for phage-producing capacity are quite different. (auth)

20587 THE SEX RATIO IN THE OFFSPRING OF IRRADIATED MALE BIRDS. Alena Lengerova and Marta Vojtiskova (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague), 7: 137-40(1961). (In English)

The sex ratio was studied in the offspring of three White Leghorn cocks irradiated locally with a gonad dose of 100 r and of 35 non-irradiated hens of the same breed. It was assumed that irradiation of the cocks would result in a deficit of heterogametic offspring, i.e. of females in the case of birds. The sex ratio in the experimental group (2511 chicks, sex determined post mortem on the first day after hatching) was 0.494 and in the control material (18806 chicks) 0.505. The anticipated increase in the sex ratio after the given radiation dose did not occur. The non-

significant decrease in the sex ratio is evidently due to other factors and not to irradiation. (auth)

20588 UNCHANGED RECOVERY OF CROSSOVERS AFTER X-IRRADIATION OF PUPAL HABROBRACON. Maurice Whittinghill and Archie Cornelious Allen (Univ. of North Carolina, Chapel Hill). Genetics, 46: 581-4(June 1961).

Recombination among haploid sons from Habrobracon mothers heterozygous for four linked markers showed no significant variation between females, or within age groups from ages 2 to 38 days, or following x-radiation doses of 1000 r, 2000 r, or 3000 r to the white pupal stage. Total fertility was increased among lower dosage females and was drastically reduced in the 3000 r group. The constancy of recombination in the wasp was attributed to the lack of synaptic chromosomes in gonial cells rather than to radioresistance of chromosomes or to complete selection against pseudocrossovers in haploid larvae and pupae. (auth)

20589 THE EFFECT OF CARBON MONOXIDE AS A RESPIRATORY INHIBITOR ON THE PRODUCTION OF DOMINANT LETHAL MUTATIONS BY X-RAYS IN DROSOPHILA. Werner Schmide (Univ. of Texas, Austin). Genetics, 46: 663-70(June 1961).

Dominant lethal damage in immature germ cells of Drosophila virilis, obtained by x radiation in CO, is drastically enhanced by the presence of very small amounts of oxygen. These small amounts of oxygen which would easily be removed by cellular respiration get access to the vicinity of the chromosomes if respiration in the cytoplasm is blocked. Post-treatment with CO + 5% O_2 for nine hours in the dark with the flies immobilized by the CO showed no effect on the x-ray-induced dominant lethal rate obtained from mature and immature stages of male germ cells. (auth)

20590 BACK MUTATION IN DROSOPHILA MELANOGASTER. I. X-RAY-INDUCED BACK MUTATIONS AT THE YELLOW, SCUTE AND WHITE LOCI. M. M. Green (Univ. of California, Davis.). Genetics, 46: 671-82(June 1961).

The induction of back mutations by x rays was studied using seven independent sex-linked mutants in Drosophila melanogaster and irradiating attached X females. Significant increases in the back mutation rates of the mutants y^2, sc, and w^a were found. No evidence was found that the back mutations were caused by recombination events or mutations to independent suppressors. Crossing over tests indicate that the back mutations are not associated with chromosome rearrangements. The problem of x-ray induction of back mutations is briefly discussed. (auth)

20591 SOME BIOCHEMICAL FACTORS IN X-RAY-INDUCED MUTATION IN BACTERIA. Tsuneo Kada, C. O. Doudney, and F. L. Haas (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston). Genetics, 46: 683-702(June 1961).

Various postirradiation treatments specifically affecting RNA or protein synthesis are effective in lowering markedly the mutation frequency response to uv light. Evidence indicates that DNA synthesis is the terminal event in UV-induced mutation, but that phenotypic expression of the genetic change involves protein synthesis subsequent to DNA synthesis. About half of the x-ray-induced reversions of the tryptophan requiring auxotroph, E. coli strain WP2, are lost, when the culture is incubated for 50 minutes with chloramphenicol or 6-azauracil, agents which block RNA or protein synthesis. A short period of incubation following x-ray exposure before addition of chloramphenicol or 6-azauracil is necessary for development of the chloramphenicol or 6-azauracil sensitivity of the mutations. These mutations require RNA synthesis, protein synthesis, and DNA synthesis for induction in a manner comparable to UV-induced reversion. The other half of the x-ray-induced mutations are not lost when incubated with chloramphenicol or 6-azauracil for 50 minutes prior to plating on tryptophan containing medium. These mutations are completely expressed when plated on minimal medium without tryptophan after a short period of incubation in tryptophan containing medium and before measurable DNA synthesis in the culture occurs. Expression does not occur in the presence of 6-azauracil or chloramphenicol. In the case of a thymineless, tyrosineless polyauxotroph, expression of the tyrosine reversion occurs in the absence of thymine for one half of the mutations while the other half requires thymine for expression. With half of the mutations which can take place in the absence of thymine, the functional reversion is produced by the x-ray in the gene, without the necessity of DNA replication, but that RNA and protein synthesis is required for gene action in phenotypic expression of the reverted character. (auth)

20592 THE LATENT PERIOD AND ITS VARIATION IN HUMAN LEUKAEMIA INDUCED BY X-RAYS. M. E. Wise (Radiological Protection Service, Sutton Surrey, Eng.). Health Phys., 4: 250-66(1961).

The distribution of time intervals between irradiation by x rays and onset of acute or chronic myeloid leukemia was investigated, in particular for the ankylosing spondylitics in Court-Brown and Doll's study series. Two methods of analysis are given in outline, both of which allow (a) for several courses of irradiation on one patient, any of which might have induced leukemia, and (b) for limited information on longer time intervals because there were many recent treatments. Intervals in subgroups, e.g. for acute leukemia only, and for doubtful cases only, are also given separately. The probability of onset is found to increase suddenly to a maximum in the fourth year after the inducing irradiation. The corresponding maximum incidence among all 3-year-old children is discussed in relation to the time intervals following irradiation of a fetus or a young baby. The analysis in general confirms that leukemia can be caused by x rays but throws doubt on the assumed linear dose-response relationships, which depend upon assuming a uniform distribution of latent periods. Accepted ideas on risk in terms of dose to the spinal marrow, and on mechanisms of induction, are briefly criticized. (auth)

20593 RELATIVE BIOLOGICAL EFFECTIVENESS OF Co^{60} γ-RADIATION FOR VARIOUS RESPONSES IN MICE. J. G. Kereiakes and M. S. Miraglia (Army Medical Research Lab., Fort Knox, Ky.). Health Phys., 5: 85-9(1961).

The biological effectiveness of Co^{60} γ radiation relative to 250 kvp x radiation for six different responses in CF_1 mice was found to be: 30-day lethality, 0.79 ± 0.06; mean survival time, 0.79 ± 0.04; body weight loss, 0.80 ± 0.04; intestinal weight loss, 1.00; splenic weight loss, 1.00 ± 0.06; and testicular weight loss. 0.63 ± 0.06. The RBE for intestinal weight loss varied with the level of the effect resulting in an average RBE determined for this response. Possible considerations for the observed differences in RBE are discussed. (auth)

20594 EFFECT OF RADIATION ON ENZYMES. II. BIOCHEMICAL EFFECT OF γ-RAY IRRADIATION ON DEHYDROGENASES. S. Tanaka, H. Hatano, and S. Genno (Kyoto Univ.). J. Biochem. (Tokyo), 46: 925-32(1956).

The inhibitory mechanism of γ rays on various dehydro-

genases was studied. Alcohol dehydrogenase of yeast and glutamic dehydrogenase of beef liver were inhibited by relatively low doses of γ rays. Inactivation of liver glutamic dehydrogenases was also found to be affected by γ radiation, the changes in its molecular structure being demonstrated by modifications in its uv absorption. DPN was, however, more resistant than apoenzymes to γ rays. The effect of γ rays on holoenzyme systems of glutamic dehydrogenase was also examined, and it was found that the larger the apoenzyme (DPN ratio) the stronger was the inhibitory effect of the irradiation. The protecting action exerted by several compounds against inactivation of glutamic dehydrogenase by γ irradiation was also studied. Reversible reactivation of glutamic dehydrogenase inhibited by the SH group reduced glutathione was also observed. (auth)

20595 STUDIES OF ULTRAVIOLET IRRADIATION OF ESCHERICHIA COLI CONTAINING 5-BROMOURACIL IN ITS DNA. S. Greer (Columbia Univ., New York). J. Gen. Microbiol., 22: 618-34(June 1960).

Thymine-requiring Escherichia coli 15, t^- and E. coli B, t^- which contained 5-bromouracil in their deoxyribonucleic acid in place of thymine showed a marked increase in sensitivity to ultraviolet (uv) radiation. The effect was proportional to the extent of incorporation of 5-bromouracil under defined growth conditions and for a given medium. This increase in sensitivity to uv was not hereditary. A maximum uv dose-increase effect on survival of 3.5 was obtained; there was as high as 20000-fold decrease in the number of survivors as compared to irradiated bacteria grown in absence of the analogue. This effect was not obtained with bacteria grown before irradiation in 2-thiothymine (an inhibitor not incorporated into DNA), nor was there an increase in uv sensitivity in organisms grown under conditions of thymine starvation or of 5-flurouracil inhibition. Furthermore, bacteria which did not require thymine and did not incorporate 5-bromouracil did not show this sensitization effect. The increase in uv sensitivity caused by 5-bromouracil was annulled by thymine. 5-Iodouracil caused a lower increase in uv-sensitization. The extent of photo-reactivation was not as great in irradiated bacteria which had been grown in 5-bromouracil as in bacteria containing no analogue in their DNA. A uv-resistant mutant of E. coli 15, t^- was isolated and found to be affected by 5-bromouracil in a manner similar to the slightly more uv-sensitive parent strain. Incorporation of 5-bromouracil did not result in a dose-increase effect on uv-induced mutagenesis at the thymine-dependent locus of E. coli 15, t^-. Bacteria containing 5-bromouracil were similarly hypersensitive to heat but showed no increased sensitivity to H_2O_2 and several nitrogen mustards. (auth)

20596 EFFECTS OF γ-RAYS ON THE SEROLOGIC PROPERTIES OF OVALBUMIN. I. IRRADIATED LYOPHILIZED PROTEIN. Charles A. Leone (Univ. of Kansas, Lawrence and Argonne National Lab., Ill.). J. Immunol., 85: 107-11(Aug. 1960).

Lyophilized ovalbumin was irradiated by means of γ rays over a wide range of dosages. From measurements of the displacement of the precipitin curve of irradiated ovalbumins from the position of the curve for native ovalbumin, the loss of activity due to primary ionizations was determined. The loss of activity was exponentially related to radiation dosage and yielded a G value of 0.88. The ionizing mechanisms of γ rays cause serologic changes similar to those reported by other workers for larger ionizing particles. (auth)

20597 EFFECTS OF γ-RAYS ON THE SEROLOGIC PROPERTIES OF OVALBUMIN. II. FRACTIONS FROM IRRADIATED LYOPHILIZED PROTEIN. Charles A. Leone (Univ. of Kansas, Lawrence and Argonne National Lab., Ill.). J. Immunol., 85: 112-19(Aug. 1960).

Samples of lyophilized ovalbumin were irradiated, under vacuum in a high energy, uniform field of γ rays, to absorb dosages of 30, 60, and 100 electron volts/molecule (6.5, 13.0, and 21.7 $\times 10^6$ rads). Solutions of the γ-irradiated ovalbumins were fractionated by promptly precipitating the radiation-denatured molecules at the isoelectric point of native ovalbumin, and by heating the neutral systems at 50, 60, and 68°C and by precipitating the thermolabile constituents at the isoelectric point. Quantitative serologic tests on the solutions revealed that the irradiated ovalbumins had a dose-related loss of correspondence to native protein. Removal of the radiation-denatured and thermolabile constituents improved the correspondence of the supernatants to the native solutions. Supernatants from native and irradiated preparations, heated at 68°C, showed thermal damage serologically. Radiation-denatured and thermolabile proteins exhibited a low, essentially constant and dose-unrelated serologic correspondence to native ovalbumin. The serologic data are interpreted as revealing, in γ-irradiated lyophilized ovalbumin, the existence of a spectrum of molecules exhibiting various degrees of structural degradation. (auth)

20598 EFFECTS OF γ-RAYS ON THE SEROLOGIC PROPERTIES OF OVALBUMIN. III. IRRADIATED SOLUTIONS. Charles A. Leone (Univ. of Kansas, Lawrence and Argonne National Lab., Ill.). J. Immunol., 85: 268-74 (Sept. 1960).

Two % solutions of ovalbumin were irradiated to absorb doses of γ rays ranging between 30 and 1000 electron volts per molecule of solution. The serologic activity of the irradiated solutions tested with antibodies to native ovalbumin declined exponentially as the dosage increased. The formation of isoelectrically coagulable protein followed a sigmoidal curve. Purified fractions of isoelectrically coagulable ovalbumin induced by radiation retained between 16 and 25% correspondence with native protein. An isoelectrically coagulable, thermolabile fraction from the irradiated systems retained between 14 and 19% correspondence with native protein. It is suggested that the loss of serologic activity, in irradiated solutions of ovalbumin, is the consequence of the cumulative effect of indirect ionizations on the molecules of protein. (auth)

20599 MECHANISM OF X-RAY EFFECT ON ANAEROBIC METABOLISM IN EHRLICH'S ASCITES CANCER CELLS. A. Hirahara (Gunma Univ., Maebashi, Japan). Kitakanko Igaku, 9: 651-67(1959).

The effect of x rays on anaerobic metabolism in Ehrlich's ascites cancer cells in Krebs-Ringer's bicarbonate solution was investigated in combination with several chemical agents. The lower pressure of oxygen was somewhat effective for x-ray damage. Increased anaerobic metabolism resulted from the administration of cysteine or glutathione, without x radiation. When these agents were given, however, just before or after x radiation, a protective effect of cysteine was observed. The effects may be based on both radiochemical and biochemical mechanisms. (auth)

20600 CLINICAL AND EXPERIMENTAL RESEARCH ON THE EFFECT OF IONIZING RADIATION ON THE TOTAL COMPLEMENT AND OF ITS FRACTIONS. B. Bellion, F. Balzola, S. Chiarle, G. Piancino, and L. Resegotti (Università, Turin). Minerva nucleare, 5: No. 1, 24-9(Jan. 1961). (In Italian)

The variations of the complement and those of its various fractions were investigated in 18 patients with malig-

nancy before, during, and after treatment with ionizing radiations. In most cases the total complement and fractions C'_3 and C'_4 were increased; a further increase of C', C'_2, and C'_3 was observed following irradiation. These variations of the total complement and complement fractions are discussed with reference to data on the physiology of complement. The results of experimental investigations on the effects of irradiation on the complement in normal rabbits are described. (auth)

20601 CIRCULATING PLATELETS IN MICE SUBJECTED TO SIMULTANEOUS X-RAY AND ULTRAVIOLET IRRADIATION. I. Cserhati, F. Krizsa, and K. Rak (University Medical School, Szeged). Nature, 190: 544-5 (May 6, 1961).

The circulating blood platelets in mice were reduced about 60% 10 days after exposure to 300 r whole-body x irradiation. When the mice were exposed to ultraviolet radiation 24 hr before the x-ray dose and platelet count did not diminish and increased 21% in 10 days. Ultraviolet irradiation administered 24 hr after x irradiation prevented a severe decrease in platelet number. Injections of blood serum from mice treated with ultraviolet radiation prevented thrombocytopenia when given within 24 hr after x irradiation. (C.H.)

20602 REVERSAL OF γ-RAY-INDUCED DORMANCY OF POTATO TUBERS BY GIBBERELLIC ACID. P. B. Mathur (Atomic Energy Establishment, Trombay, India). Nature, 190: 547-8(May 6, 1961).

Potatoes exposed to doses of 8000 or 12000 rads of γ radiation sprouted after treatment with solutions of gibberellic acid. New buds appeared adjacent to those which had degenerated after radiation exposure. It was concluded that γ irradiation impairs an endogenous gibberellin-synthesizing mechanism in the potato and that the effects of this damage can be counterbalanced by exogenous gibberellic acid. (C.H.)

20603 FORMATION OF AN OMMATIN PIGMENT FROM TYROSINE BY ULTRA-VIOLET IRRADIATION. Maria Benigna Johnson (Saint Joseph Coll., West Hartford, Conn.). Nature, 190: 924-5(June 3, 1961).

Changes in absorption spectra brought about by increasing dosages of ultraviolet radiation on tyrosine indicate the formation of an ommatin pigment with maximum absorbance in the ultraviolet at 245 mμ, with a second peak at 300 to 305 mμ. This formation is probably the result of the irradiation which in effect caused the oxidation of the dihydroxyindole with the breaking of the 2:3 bond of the pyrrole ring. This bond separation gives rise to an o-aminophenol which reacts with the DOPA quinone to form the ommatin pigment. The yellow pigment is extracted by salting out with sodium chloride and shaking with isobutyl alcohol. This formation is non-enzymatic. (N.W.R.)

20604 HISTOLOGICAL INVESTIGATION ON THE "PREMATURE DEATH" OF X-IRRADIATED DROSOPHILA EGGS. Lieselotte Steenbeck (Max-Planck-Institut für Biophysik, Frankfurt am Main). Naturwissenschaften, 48: 310(1961). (In German)

A histological study was made of the premature death of Drosophila eggs, 1.5 hrs old, exposed to doses of x radiation from 250 to 3000 r. At various times after the irradiation the embryos were fixed by the Huettner method, and the development stage was microscopically determined. The results show that after a dose of 3000 r 75% of the eggs have the histological state of 1.5-hr controls. The distribution of the development stages, compared to the development of controls, is tabulated. None of the irradiated eggs attain the development of the controls. (J.S.R.)

20605 EFFECTS OF RADIATION ON NUCLEIC ACID METABOLISM IN MICE. I. STUDIES ON RADIOSENSITIVITY OF VARIOUS ORGANS. G. Yamamoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 477-87 (1959).

The weight and nucleic acid content of the thymus, spleen, liver, and testis in mice were measured after x irradiation. As for nucleic acid metabolism, the thymus, spleen, and testis were highly radiosensitive. On the contrary, the liver was relatively radioresistant. Nucleic acid metabolism after irradiation was divided into 2 phases: in the first the synthesis of nucleic acid was depressed markedly, and in the second recovery from the depression occurred. With whole-body irradiation by supralethal dose the second phase was absent, and organ weight as well as nucleic acid content decreased gradually, and no recovery occurred. Even when the thymus and testis were shielded from x rays, indirect effects from the remaining portion of the body were observed. The nucleic acid metabolism in the thymus, spleen, and testis was disturbed by exposure to sublethal doses of 200 to 300 r. (auth)

20606 EFFECT OF X-RAYS ON THE AFFINITY OF THE LIVER FOR PROTOPORPHYRIN III. M. Kawade (Mei Prefectural Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 835-66(1959).

Guinea pigs were exposed to x rays, and the change of the affinity of the liver for protoporphyrin III was studied. In the group given total body irradiation of 100 r, a slight change of parenchymal cells in the perilobular region with some decrease of the affinity for protoporphyrin was observed, but 14 days after the irradiation both parenchymal cell findings and the affinity had returned to normal. Moderate degeneration of the parenchymal cells resulted from 400 r of total body irradiation; 1000 r of total body irradiation caused widespread degeneration. Decreased affinity for protoporphyrin III was a common finding in both cases. However, there were no changes in the interstitial tissue and epithelial cells of the bile ducts. An increase of Kupffer's cells was observed in the recovery stage. These changes seen after relatively small doses may be due to an indirect action of x rays, since a similar result was obtained when the hepatic region was shielded during irradiation. (auth)

20607 EFFECT OF X-RAYS ON DYE EXCRETORY FUNCTION OF THE LIVER. II. EFFECT OF X-RAYS ON LIVER FUNCTION. T. Kakae (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 918-34(1959).

The effect of x radiation on liver function was examined in rabbits by using the bromsulfalein test. Hepatic irradiation in doses of more than 2000 r strongly impaired the dye excretory function of the liver. However, when vitamin B_2, B_{12}, or glucuronic acid was administered parenterally every day after irradiation, this disturbance was diminished. The bromsulfalein test in patients receiving deep x-ray therapy over the upper abdomen showed similar results, especially when x-ray doses totalled 10000 r. (auth)

20608 THE EFFECT OF X-RAYS ON URINARY EXCRETION AND DISTRIBUTION IN VARIOUS ORGANS OF P^{32} AND I^{131}. Y. Moriya, T. Yamada, I. Konno, T. Soo, and K. Ra (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 972-84(1959).

Rabbits were exposed to renal x irradiation from 50 to 8000 r after administration of P^{32} or I^{131}. Regardless of the dose of x rays given, urine decreased markedly in quantity. P^{32} in the bladder as well as in urine was decreased in accordance with x-ray doses, while P^{32} in blood

and in the renal region was increased. It was observed that I^{131} accumulated mainly in the thyroid. The results indicate that when the kidneys are exposed to x rays renal function is more or less disturbed. (auth)

20609 EFFECTS OF RADIATION ON NUCLEIC ACID METABOLISM IN MICE. II. EFFECT OF BETA-MERCAPTOETHYLAMINE-HCl (MEA) AND BETA-AMINOETHYL-ISOTHIURONIUM-HBr (AET) ON NUCLEIC ACID CONTENT IN THE THYMUS, SPLEEN AND TESTES. G. Yamamoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1003-11(1959).

Effects of chemical protective agents on nucleic acid metabolism after irradiation were studied, using adult mice of (NH × CBA) F_1, $C_{57}Bl$, and CBH strains. MEA was administered intraperitoneally 10 to 30 min before or after x irradiation with 300 r, while AET was administered before x irradiation with 680 r. When MEA was injected, the nucleic acid metabolism in the thymus and spleen was appreciably depressed about one day later. In the spleen as well as in the testis, only the post-treatment was protective against x irradiation, particularly when MEA was administered in the most depressed stage of metabolism. Neither MEA nor AET was effective, as pre-treatment. (auth)

20610 THE EFFECT OF X-RAYS ON LIVER FUNCTION IN PATIENTS WITH MALIGNANT TUMORS. H. Soeda (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1064-88(1959).

A statistical analysis was made of liver function in 86 patients with malignant tumors before and after x-ray treatment. Before irradiation considerable hepatic dysfunction was found by an abnormal Kunkel zinc sulfate test in 31% of the patients, sublimate turbidity reaction in 36.2%, BSP test in 44.2%, bilirubinemia in 10.1%, and serum cholinesterase in 47.8%. Normal liver function was observed in only 21.8%. The 5 tests, except for bilirubinemia, were statistically abnormal as compared with normals. These tests carried out after the operative removal of the tumors showed marked recovery of liver function. X-ray treatment, especially when the abdomen was irradiated, acted very unfavorably on liver function. (auth)

20611 HISTOLOGICAL CHANGES IN THE ADRENAL GLANDS OF P^{32}-INJURED FOWLS. II. ADMINISTRATION OF 2.0 μc. OF P^{32}/g. BODY WEIGHT. S. Morita (Japanese Veterinary Zootechnical Coll.). Nippon Jui Chikusan Daigaku Kiyo, 8: 75(1959).

Growing chickens weighing about 400 g were injected with 2.0 μc P^{32}/g. The histological changes in their adrenal glands were examined after 5, 10, 15, and 22 days. The medullary and chromaffin cells and their nuclei were enlarged possibly because of suppression of mitosis. The amount of chromatin was decreased, a few clumps being dispersed through the nuclei. There was evidence of karyolysis. These results coincide with those of other investigators but are not sufficient to indicate whether the function of the adrenal gland is impaired. (auth)

20612 EFFECT OF X-RAYS ON OXIDATION OF FATTY ACIDS IN THE LIVER. II. EFFECTS OF X-RAYS ON METABOLISM IN RATS. S. Han, T. Uenishi, and K. Nagasawa (Osaka Municipal Medical Coll.). Nippon Igakurigaku Zasshi, 54: No. 6, 1352(1959).

The oxidation of fatty acids was increased in rats exposed to total body or adrenal region x irradiation; with adrenal region irradiation this effect lasted relatively long. No effect was seen in rats exposed to adrenal region irradiation after surgical removal of the adrenal gland. The effect of the joint used of total body and adrenal region irradiation was almost the same as that of single adrenal region irradiation. Liver irradiation had no effect. (auth)

20613 MODIFICATIONS OF THE RADIOSENSITIVITY OF WALKER TUMORS INDUCED IN OXYGEN ATMOSPHERE. Z. Fumagalli, M. Lupo, G. Pisani, and U. Colombo (Università, Messina, Italy and Centro Studi di Radiobiologia Sperimentale Ospedale Maggiore, Novara, Italy). Radiobiol. latina, 3: 193-207(July-Sept. 1960). (In Italian)

The volume and structure of Walker tumors grafted subcutaneously in rats and x rayed while the animal was in an atmosphere of oxygen were studied. Tumors of 450 to 500 mm^3 showed a 65% greater reduction in volume when given 1000 rads at 20°C in O_2 at 1 atmosphere compared with controls irradiated in air at 1 atmosphere. Under similar conditions, tumors of 1250 to 1300 mm^3 showed a reduction in volume of only 10% or so when irradiated in oxygen compared with air, but increasing the dose to 2000 rads resulted in a difference of the same magnitude as that found for the smaller tumors treated with 1000 rads. Increasing the oxygen tension to 2 atmospheres enhanced slightly the regression of the larger but not of the smaller tumors. Histologically, it was found that damage to the neoplastic cell was greater for the same dose in oxygen as compared with air and also that cells embedded in the capillary network in the vicinity of arterioles showed more severe damage than those associated with the capillary network near venules. Besides focussing attention on the particular conditions in which phenomena of radiobiological interaction are revealed these experimental observations confirm once more the possibility of an "oxygen effect" even in higher organisms and permit phenomena of greater complexity in relation to the characteristic vascular patterns of organs to be envisaged. (auth)

20614 THE RENAL FUNCTIONING IN IRRADIATED PATIENTS. U. Nuvolone and G. Pisani (Centro Studi di Radiobiologia e Cancerologia, Ospedale Maggiore, Novara, Italy). Radiobiol. latina, 3: 217-43(July-Sept. 1960). (In Italian)

The general and selective functional capacity of the kidneys during the early and late post-irradiation period in cancer patients who had received x-ray treatment or teletherapy using Co^{60} at different parts of the body but including the kidneys of part of them was studied. The following facts were observed. A dose of 2000 r at a section of the body including the entire renal field can produce early changes as shown by test of glomeralar and tubular function. The maximum tubular excretion of paminohippuric acid (Tm PAI) is a particularly sensitive and useful measure of renal failure during the early post-irradiation period. Irradiation of the pelvis can affect urinary excretion either early or late in the post-irradiation period (cicatricial stenosis of the lower urinary passages). Even very high doses given to large volumes of the other parts of the body, e.g., thorax, do not produce any alteration in renal function secretory or excretory. On the basis of these results, it is concluded that, when inclusion of the kidneys in the irradiation field is unavoidable, it is essential to minimize the amount of renal parenchyma included. Renal function should be followed, especially by tests of tubular function, so that the radiotherapy can be interrupted at the right time and appropriate medical treatment given. (auth)

20615 EFFECT OF IONIZING RADIATION ON THE KINETICS OF MITOSIS. [PART] II. G. Astaldi, E. Strosselli, A. Pisani, and G. Paolucci (Istituto "Città di Pavia" e Ospedale di Tortona, Italy). Radiobiol. latina, 3: 245-52(July-Sept. 1960). (In Italian)

Interference by ionizing radiation with the development and duration of ana-telophase in in vitro cultures of undifferentiated mesenchyme was studied. It was observed that even high doses of x rays did not inhibit the development of anatelophase or apparently affect its duration. High doses did, however, arrest metaphase. (auth)

20616 THE POSSIBILITY OF A RADIORESISTANCE INDUCED IN LYMPHATIC TISSUE BY A PRECEDING IRRADIATION. E. Turolla, A. Trenta, and G. Aliprandi (Università, Pavia, Italy and Università, Milan). Radiobiol. latina, 3: 263-9(July-Sept. 1960). (In Italian)

The possibility that radioresistence might be induced in lymphatic tissues by previous irradiations was investigated. As far as could be determined by purely morphological methods, the response of the lymphatic component of the lateral cervical lymph node of the guinea pig to 2000 r was not appreciably modified by a previous dose of 8000 r given 45 days earlier. Genesis during the first irradiation of a radioresistant population of lymphocytes which conferred any definite increase in the resistance of the lymph nodes to succeeding irradiations was excluded. (auth)

20617 CHARACTERISTIC BONE LESIONS IN POST-IRRADIATED CARCINOMA OF THE CERVIX. Philip Rubin and Dusdee Prabhasawat (Univ. of Rochester, N. Y.). Radiology, 76: 703-17(May 1961).

The characteristic appearance of bone metastases and destruction in cervical carcinoma reflects its mode of spread. Three groups are recognized: direct extension, lymph-node involvement, and hematogenous metastases. The changes are mainly a result of direct invasion of bone from adjacent cancer-infiltrated tissues or lymph nodes. In direct extension, the initial changes in pelvic bones are dissolution of the cortex along the sacrosciatic notch or loss of the iliopectineal line. In lymph-node metastases, the earliest vertebral changes are a loss of body substance, rendering the articular processes on the involved side more apparent. Advanced lesions characteristically show extensive destruction of adjacent bones, joints, and intervertebral spaces, associated with a large soft-tissue mass due to aggressive local invasion and spread. Hematogenous metastases are indistinguishable from those of other neoplasms but are worthy of note because of their rarity and aggressiveness. Radionecrosis of the pelvis is readily distinguishable from metastatic involvement because of the absence of osteolysis and cortical destruction coupled with a predictable pattern of bone selerosis and fracture in femora, pubis, and ilia, depending on portal arrangements. Therapeutic measures are dependent on proper diagnosis and clinical judgment. (auth)

20618 EFFECTS OF INTENSIVE RADIATION ON THE HUMAN HEART. Jerome M. Vaeth, Lawrence Z. Feigenbaum and Malcolm D. Merrill (Univ. of California, School of Medicine, San Francisco). Radiobiology, 76: 755-62 (May 1961).

In 20 patients receiving large doses of radiation to the heart, no significant cardiac damage was detectable clinically or by electrocardiograms or serum glutamic oxalacetic transaminase determinations. In 1 patient who received over 6000 rads to the heart, a detailed histologic examination showed no cardiac damage attributable to radiation. In 2 patients electrocardiographic evidence of pericarditis developed during treatment for masses involving the mediastinum. The pericarditis was transient, did not interfere with continuance of radiotherapy, and had subsided completely at the end of treatment. Pericardial involvement was proved by surgery in 1 patient prior to the initiation of radiation therapy. In the other, at the time of development of the pericarditis, roentgenograms revealed the mediastinal mass to be diminishing in size. It is more likely, therefore, that the pericarditis was due to irradiation, rather than to the neoplastic disease. The absence of abnormal serum glutamic oxalacetic transaminase determinations is compatible with pericardial rather than with myocardial reaction. In 4 patients with electrocardiographic changes suggestive of reversible myocardial damage, only 1 had simultaneous serum glutamic oxalacetic transaminase elevations. It is doubtful that the findings were caused by the dose delivered at this time, although the possibility exists. If cardiac damage is induced by irradiation, it appears to be of such insignificance that modification of adequate present-day radiotherapeutic technics is not justified. (auth)

20619 EFFECTS OF X-IRRADIATION ON CHICKENS AS REVEALED BY SEROLOGICAL ANALYSIS. I. WHOLE PLASMA COMPARISONS. Charles A. Leone (Univ. of Kansas, Lawrence). Trans. Kansas Acad. Sci., 60: 301-15 (1957).

White leghorn chickens weighing between three and five pounds were given whole-body, single dose exposures to x rays at 33 r per minute, and the post-irradiation changes in the serological activity of their plasmas were followed by means of a turbidimetric analysis of the precipitin reaction. Antisera produced in rabbits against normal plasmas of chickens were able to distinguish plasmas from birds which had received 660 and 990 r. An exposure of 330 r caused no significant alterations in the serological activity of the plasmas of chickens. A dose of 660 r depressed the serological activity of the plasma at the end of 24 hours. By three days the original plasma reactivity was restored; at 30 and 60 days following irradiation the serological reactivity of the plasmas greatly exceeded the controls. A dose of 990 r caused a depression of serological reactivity of the plasma within 24 hours, and which was maximal within seven days. The induced changes persisted for 60 days. The principal changes occur in the β globulins of the plasma. Quantitative increases were induced in these proteins with 660 r, and qualitative alterations were induced with 990 r. To a small extent by 660 r, and to a greater extent by 990 r, the albumins of the plasmas are increased in concentration following irradiation. All of the chickens that were exposed to a dose of 1320 r died within 24 hours. (auth)

20620 PAPER ELECTROPHORETIC STUDIES ON γ-IRRADIATED, LYOPHILIZED OVALBUMIN. Charles A. Leone and Kenneth Perry (Univ. of Kansas, Lawrence). Trans. Kansas Acad. Sci., 63: 44-52(1960).

Lyophilized ovalbumin was irradiated with γ rays to absorb 13×10^6 rads. The protein was dissolved at 0°C between pH 7 and 9. Radiation-denatured protein was precipitated by promptly readjusting the solution to pH 4.85. The supernatant was raised to pH 7.2 and heated at 5°C. Thermolabile components precipitated when the pH was again lowered to 4.85. Two more thermolabile fractions were obtained by successively heating the neutral supernatants at 49.5°C and 60.0°C and adjusting the solution to pH 4.85. The precipitates were all readily soluble at pH 7.2. Paper-strip electrophoresis of solutions of both native and irradiated ovalbumin and of the several supernatants, thermolabile fractions and the radiation-denatured protein revealed the existence of a spectrum of molecules in variously damaged states. (auth)

20621 EFFECT OF RADIOACTIVE PHOSPHORUS (P^{32}) ON THE BLOOD CELLS AND OTHER TISSUES OF THE COTTON RAT, SIGMODON HISPIDUS. Robert M.

Hankins. Univ. Kansas Sci. Bull., 36: (Pt. II) 1389-1421 (July 15, 1954).

Normal values for erythrocyte volume, sedimentation rate, hemoglobin, total erythrocyte and leucocyte numbers, and differential leucocyte counts are given, and seven graphs show the effects of radiation upon each of these constituents of the blood, and upon several tissues and organs. Thirteen tables and one graph present data on breeding records of Sigmodon, age at sexual maturity, number of young per litter, growth rates of males and females, determination of LD 50/30-day dosage of P^{32} for Sigmodon, values of several constituents of the blood before and after irradiation, and the rate of loss of P^{32} from tissues and organs following treatment with radioactive phosphorus. The LD 50/30-day dosage of P^{32} for Sigmodon is determined to be 4.3 μc per gram of body weight. (auth)

20622 SEROLOGICAL AND CHEMICAL STUDIES OF GAMMA-IRRADIATED OVALBUMIN. Charles A. Leone and M. Elizabeth Wesley (Univ. of Kansas, Lawrence and Argonne National Lab., Ill.). Univ. Kansas Sci. Bull., 41: 633-56(Dec. 1960).

Lyophilized ovalbumin irradiated with gamma rays so as to absorb 15, 30, and 60 electron volts per molecule of protein possessed molecules in various stages of structural degradation. The most severely damaged molecules precipitated at the isoelectric point of native ovalbumin. Less severely damaged molecules did not precipitate at the isoelectric point but exhibited different degrees of thermolability. The different stages of degradation of these thermolabile components were demonstrated by heatings at 50, 60, and 68°C and then precipitating them at the isoelectric point. Serological testing provided a sensitive means of detecting alteration of the protein molecule by irradiation. As the irradiation-altered molecules were removed, the serological activity of the protein remaining in the supernatants tended to approach the serological activity of the native ovalbumin. Whether or not the denatured fraction retained any serological activity at all is questionable. (auth)

20623 THE ROLE OF "FREE RADICALS" IN RADIATION. Richard H. Sands (Univ. of Michigan, Ann Arbor). p.27-30 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

The chemical and physical evidence for free radicals in chemical and biological systems that have been subjected to radiation is reviewed. (C.H.)

20624 EFFECTS OF IONIZING RADIATION ON NUCLEOPROTEINS. Ernest C. Pollard (Yale Univ., New Haven). p.38-44 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Results are reported from studies on the effects of radiation on nucleoproteins. Both direct and indirect effects of radiation on proteins, nucleic acids, ribosomes, and viruses are considered. Data are tabulated from a series of studies on the uptake of amino acids by irradiated Escherichia coli. Factors affecting the radiosensitivity of nucleoproteins are discussed. (C.H.)

20625 RADIATION EFFECTS ON GENETIC SYSTEMS. Irwin I. Oster (Inst. for Cancer Research, Philadelphia). p.45-50 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Some of the effects of radiation on genetic systems are discussed, with special reference to the consequences of x-ray-induced damage in the hereditary material of somatic cells. On the basis of survival rates of x-irradiated strains of Drosophila melanogaster, it is suggested that premature aging in animals is brought about by chromosome loss produced by radiation. The possibility that this phenomenon is also involved in other radiation-induced effects, such as tumor formation and tumor regression, is also considered. (auth)

20626 CHANGES IN MODAL VALUES OF CHROMOSOMES AFTER IRRADIATION OF HUMAN AMNION CELLS. Masahiro Mizutani, Yasushi Ohnuki, Y. H. Nakanishi, and C. M. Pomerat (Univ. of Texas Medical Branch, Galveston). p.51-60 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

A population of human amnion cells with a modal value of 75 chromosomes, that received 1000 r from a Co^{60} source showed severe injury. On cultivation, healthy looking cells were restored; however, they now had 73 chromosomes. Repetition of this treatment on the new subline reduced the modal value of chromosomes to 71. Further reduction of this value did not occur after irradiation for the third and even for the fourth time. Human amnion cells were irradiated 4 times during 50 days without making subcultures. The most frequent chromosome number at the eleventh subculture of the established subline dropped from 75 to 71. The new stem line that was established after irradiation may have appeared in the cell population as a result of selective adaptation that occurred during the heteroploid transformation of diploid cells. The ideogram for the stem cells in control and each subline suggests that the changing of the karyotypes occurred after irradiation. The fact that regular reductions of the modal value of chromosomes after irradiation stopped at 71 and no obvious changes were obtained after additional irradiation invites further study concerning this type of radioresistance. (auth)

20627 THE MODIFICATION BY CHEMICAL AGENTS OF BIOLOGICAL RESPONSE TO IRRADIATION. L. H. Gray (Mount Vernon Hospital, Northwood, Middx., Eng. and Radium Inst., Northwood, Middx., Eng.). p.70-96 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Modifications in the biological response to radiation induced by means of chemical agents are discussed. Agents considered include oxygen, nitric oxide, inert gases under pressure, sulfur-containing compounds such as hydrogen sulfide and p-chloromercuribenzoate, alcohols, glycols, glycerine, pharmacologically active substances, and chemical radiosensitizers such as Synkavite. Reaction mechanisms involved are discussed. 176 references. (C.H.)

20628 LATE EFFECTS OF RADIATION. Austin M. Brues (Argonne National Lab., Ill.). p.97-9 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

The late deleterious effects of radiation are discussed from the standpoint of those changes that occur more or less universally in individuals receiving equivalent degrees and modes of exposure and those changes that are essentially of a statistical nature and can be recognized only by the study of large groups of individuals receiving similar exposures. The first category includes the classical pathology of irradiation damage which is manifest when relatively large doses are given. The second category includes those phenomena that occur only in some proportion, actually a small one, of individuals subjected to identical treatment. The study of such effects requires very large populations to yield valid information on effects or lack of effects fol-

lowing irradiation by low-level doses. Statistical studies on radiation effects underway at the present time are reviewed. (C.H.)

20629 TIME-DOSE RELATIONS IN RADIATION EFFECTS. Henry Quastler (Brookhaven National Lab., Upton, N. Y.). p.100-12 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961. (BNL-4899)

The time factors in response to radiation are manifold and complex, and it would be an anachronism in 1960 to speak of the protraction effect and the fractionation effect. However, a simple cumulative dose model seems to fit moderately well the fractionation effects found with the skin erythema reaction and also several therapeutic responses. With the help of this model, promising approaches to future time factor research can be defined, which should be helpful particularly in analyzing the behavior of individual cells. With entire cell populations, and especially with tissues containing more than 1 type of cell, complicating factors arise because the entire pattern of radiation response can be affected by the initial irradiation. Many situations will have to be investigated experimentally and theoretically before generalizations can be made with confidence. (auth)

20630 OXYGEN EFFECT ON RADIOSENSITIVITY. I. Churchill-Davidson (St. Thomas' Hospital, London). p.122-32 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Preliminary results are reported from 92 cancer patients given radiation therapy while breathing oxygen at 3 and 4 atmospheres of absolute pressure. The technique and equipment are described. Data are tabulated on patients who survived more than 2 years after treatment without evidence of recurrence. Types of tumors treated include larynx and pharynx, tongue, vollecula, tonsil, palate, bladder, bronchus, bone, esophagus, brain, uterine cervix and vagina, lip, parotid, adrenal, and soft tissue. Results of these clinical trials suggest that the addition of oxygen markedly increased the effectiveness of radiation treatment. (C.H.)

20631 AN EYE SURVEY IN NUCLEAR REACTOR WORKERS TO DETECT RADIATION CATARACTS. George L. Voelz (U. S. Atomic Energy Commission, Idaho Falls, Idaho). p.564-9 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

The etiology of cataracts induced by radiation exposure is discussed. A program of eye examinations designed to determine early radiation effects was begun at the National Reactor Testing Station in 1952. Pre-exposure and periodic examinations on certain employee groups have been continued from that time to the present. Results are reviewed from a total of 516 examinations performed on 379 individuals in whom 34 cataracts were observed. Data on posterior lens findings and cataract induction are discussed from the standpoint of radiation exposure. (C.H.)

Radiation Sickness

20632 PROBLEM OF THE USE OF VITAMIN C IN RADIATION SICKNESS. A. V. S. Iusipov. Biophysics (U.S.S.R.) (English Translation), 5: 724-5(1960).

A study was made on the effects of ascorbic acid on the course of radiation sickness in rabbits. Administration of ascorbic acid before irradiation had an unfavorable influence, but a distinctly favorable effect when administered 20 hr and later after irradiation. (C.H.)

20633 STUDIES ON HOMOLOGOUS BONE MARROW TRANSPLANTATION IN IRRADIATED RABBITS. Sergio Piomelli and Marcus S. Brooke (Peter Brigham Hospital Boston and Harvard Medical School, Boston). Blood, 17: 579-96(May 1961).

White New Zealand rabbits were exposed to 1100 r of x radiation and transplanted with fresh or frozen, lyophilized, sonicated homologous bone marrow. Fresh marrow was infused 24 hours or 72 hours after x irradiation. All these animals received antibiotics and, in addition, another group received antibiotics only. Donors were females differing, on the basis of Cohen's Hg^{ADF} allelomorphic system for erythrocytes, from the recipient males. It was therefore possible to follow the success of the graft qualitatively by the occurrence of female heterophil leukocytes, and semiquantitatively by the presence of donor erythrocytes in the circulation of the recipient. Complete correlation between these two parameters did not occur: sometimes leukocytes, sometimes erythrocytes, and sometimes both elements of the donor were found in the circulation of the recipient. If animals retained their graft, complete repopulation with donor erythrocytes occurred at about the tenth week postirradiation and transplantation. The number of donor leukocytes present in the blood of the chimeras suggested a mixed population. Not only were the grafts often incomplete but in many instances they were not permanent. Initially, all but one animal had a successful graft, but of the 18 animals which had received fresh marrow and survived at least 12 weeks 12 retained their graft. Much better results in terms of permanent takes were obtained when the marrow was infused 24 hours, rather than 72 hours, after x irradiation. Nonviable marrow had no protective effect, whereas antibiotics did decrease the mortality. An immune hemolytic anemia was shown to be part of the secondary disease syndrome. Antibodies specific to stored recipient erythrocytes were found in the sera of all chimeras between the third and seven weeks after transplantation. When donor erythrocytes were used, the test was positive on only 3 animals. These 3 animals died between the third and eighth weeks postirradiation with secondary disease. When stored recipient erythrocytes were thawed, labeled with Cr^{51}, and infused into chimeras three or four weeks after irradiation and transplantation, they had in every case a greatly shortened half-life commensurate with a hemolytic anemia. Donor erythrocytes were infused into other chimeras and in all but one instance had a normal half-life. It is suggested that all rabbit chimeras develop secondary disease to some extent, as indicated by a weight loss and fall in hematocrit, but that the situation is not necessarily fatal, except when recovery of the host's immune mechanism occurs in the presence of a graft which is actively producing antibodies against the host. (auth)

20634 NUCLEAR INCIDENTS FROM NON-CONTROLLED CRITICAL EXCURSIONS AND THERAPY OF ACUTE RADIATION SYNDROME. Sergio Lin (Ospedale Maggiore, Trieste). Minerva nucleare, 5: No. 1, 5-21 (Jan. 1961). (In Italian)

Nuclear accidents from uncontrolled supercriticality which took place in several nations from 1945 to 1958 are discussed. A survey was made of the characteristics of the equipment involved in these accidents and of their mechanism. These accidents concerned critical assemblies, subcritical reactors, power reactors, and parts of

fissionable material processing plants. The symptoms of the acute radiation syndrome were illustrated in relation to the dose of radiations absorbed and the manner of absorption of ionizing radiations. Recommended therapeutic procedures in acute radiation disease are graphed in three steps: a) general emergency therapy; b) symptomatic therapy; and c) causal therapy. Recent progresses in the chemistry of chelating agents and the most valuable procedures for increasing the excretion of radioactive substances from the human body are discussed. (auth)

20635 NITROGEN PROTECTION OF FECUNDITY AND FERTILITY IN FEMALE HABROBRACON TREATED WITH X-RAYS. Daniel S. Grosch (North Carolina State Coll., Raleigh) and Arnold M. Clark. Nature, 190: 546-7(May 6, 1961).

Nitrogen gas replacement anoxia afforded nearly complete protection from the effects of 2500 r in all the cell types present in Habrobracon polytrophic ovarioles comprised of differentiated, transitional, and primitive cells. Sulfhydryl compounds afforded only limited protection during this sensitive period. Possible reaction mechanisms are discussed. (C.H.)

20636 EFFECT OF VITAMINS ON THE LIFE SPAN OF MICE EXPOSED TO TOTAL BODY X-IRRADIATION OF HALF LETHAL DOSES. K. Hirakawa (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 832-52(1959).

The effect of total body x irradiation on mice with avitaminosis (A, B_1, B_2, B_6, B_{12}, K, or E) was compared with that on mice given vitamins in large doses. Vitamin-deficient mice were generally more radiosensitive and irradiation shortened their lives more easily, but B_6-deficient groups were radioresistant. B_{12} or K was effective against irradiation but other vitamins, though given in large doses, had little or no influence. (auth)

20637 STUDIES ON PROTECTIVE SUBSTANCES AGAINST RADIATION HAZARD. M. Namiki. Rikagaku Kenkyusho Hokoku, 35: No. 2, 167-75(1959).

Protective effects of various chemical substances against radiation were studied by means of survival rates of mice. There were about 40 kinds of substances such as amine or phenol compounds, sulfur compounds, AET derivatives, RNA, etc. Histamine and cysteine and imidazole derivatives were most effective. Combinations of histamine and antihistamine were also effective. (auth)

CHEMISTRY

General and Miscellaneous

20638 (BM-RI-5787) COMPUTED COMPOSITIONS AND THERMODYNAMIC PROPERTIES OF DEUTERIUM-AIR FLAMES. Edwin B. Cook and Robert W. Smith, Jr. (Bureau of Mines. Explosives Research Lab., Pittsburgh and Bureau of Mines, Pittsburgh). Aug. 1960. 25p.

Calculations are described for thermodynamic properties of gases from constant-pressure burning. Results are tabulated for equilibrium values, enthalpies, energies of the gases, heats of formation, constant-pressure and constant-volume heat capacities, and free energy functions as functions of deuterium content, pressure, and temperature. (B.O.G.)

20639 (HW-59029) THE DECONTAMINATION OF REACTOR COOLING WATER WITH ALUMINUM. W. B. Silker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 28, 1959. 14p.

The decontamination efficiencies for removal of several radioactive species from reactor cooling water by passage through a bed of aluminum turnings were measured. After equilibrium was attained, measured removals were 45% Mn^{56}, 65% As^{76}, 25% Np^{239}, 43% P^{32}, and 64 and 50% Cu^{64} and Zn^{65}, respectively. It is proposed that the removal mechanism at equilibrium is a reaction between the ions from solution and the fresh aluminum oxide corrosion product surface. These removal efficiencies should be maintained until depletion of the aluminum metal. This treatment shows promise of being a simple and economical method for decontamination of reactor cooling water prior to discharge to the Columbia River. (auth)

20640 (NP-10191) THE PREPARATION OF FLUORINE-CONTAINING COMPOUNDS. Terminal Report. Henry C. Brown (Florida. Univ., Gainesville). 1960. Contract Nonr 580(03). 35p.

Many new areas of the chemistry of fluorocarbon derivatives were explored in order to find new ways of synthesizing high-molecular-weight, thermally stable, and corrosion-resistant polymers. The most promising reaction for such synthesis was found to be the condensation of perfluoroalkyl amidines to form sym-triazines. Other reactions described are addition of hydrazine to perfluoroalkyl nitriles; reaction of perfluoropropene with sulfur; dimerization, trimerization, and polymerization of unsaturated fluorocarbons. (D.L.C.)

20641 (NP-10214) SYNTHESIS AND EVALUATION OF NEW POLYMERS PREPARED BY STEREOSPECIFIC CATALYSIS. Quarterly Progress Report No. 4, January 1–March 31, 1961. Charles G. Overberger (Brooklyn. Polytechnic Inst.). Contract AF33(616)-6866. 59p.

A copolymerization product of styrene and p-tert-butylstyrene was fractionated and was found to be composed of more than one kind of copolymer. Similar results were obtained with styrene and o-methylstyrene. An improved method of obtaining β-methyl-ϵ-caprolactam was developed. 6-Hydroxy-3-methylethyl hexanoate and 6-hydroxy-5-methylethyl hexanoate were synthesized. Isobutylene and p-chlorostyrene were copolymerized using aluminum bromide as initiator in ethylene dichloride to give copolymer composition between that obtained in hexane and nitrobenzene. (auth)

20642 (NP-10215) MONTHLY REPORT, DEVELOPMENT, APRIL, 1961. (Eldorado Mining and Refining Ltd. Research and Development Div., [Ottawa]). 20p.

The results of atmospheric carbonate leach tests on feed prepared from mill head samples are summarized. As in previous tests, uranium extraction from the mill heads was somewhat higher than from flotation tails. In the precipitation of diuranate by caustic soda using the recycling technique, the effects of NaOH and $NaHCO_3$ concentration in the pregnant solution at the time of adding recycled slurry were investigated. Results of tests performed on amalgam reduction of Beaverlodge pregnant solution are presented. Amalgam reduction was obtained at high reduction efficiencies, accompanied by limited hydrogen evolution, when an electromagnetically driven mixer was used for contacting. A study was made of the effect of adding nitric acid to the strip water using a head sample of scrubbed extract for uranium re-extraction in a pulse column. Metallographic examination was made of all samples of NRV and NRX production rods from the AS series. Magnesium reductions of uranium oxides were carried out in the thermobalance under an atmosphere of argon. Reductions of sodium and magnesium diuranates with metallic aluminum were attempted. It was found that approximately 4 times stoichiometric aluminum was required to obtain reasonable phase separation. In the preparation of UAl_2, the carbon pick-up varied between 0.22 and 0.75%. In the aluminum reduction of U_3O_8, carbon pick-up varied between 0.1 and 0.5%. Fe–U compacts were prepared using iron filings and either uranium metal lathe turnings or draw bench turnings. U_3O_8 was reduced with FeSi at temperatures between 1500 and 2100°C. Attempts were made to reduce the fluoride content of an ADV prepared from uranyl fluoride by calcination. A colloidal UO_2 was prepared by electrolyzing a solution of UO_2Cl_2. UO_2 fusions were attempted unsuccessfully in a graphite crucible under argon atmosphere. (M.C.G.)

20643 (NP-10224) THE SYNTHESIS OF UNSATURATED FLUOROCARBONS. Quarterly Report 39: December 13, 1960–March 13, 1961. Paul Tarrant, David E. O'Connor, and Frank J. Pisacane (Florida. Univ., Gainesville). Contracts MIPR 33(616)-5701 and DA-19-129-QM-500. 9p.

Optimum conditions ($AlCl_3$ as catalyst and dimethyl formamide as solvent) were derived for the formation of $CF_2ClCFClNO$ (56%) from $CF_2=CFCl$ and NOCl. NOCl underwent little or no reaction with $CCl_2=CCl_2$, $CCl_2=CHCl$ or $CF_3CCl=CClCF_3$. $Hg(CF_3CHF)_2$ was prepared from $CF_2=CFH$ and HgF_2 which with NOCl gave a nitroso compound (14%). Butadiene and 2,3-dimethylbutadiene with $CF_2ClCFClNO$ gave Diels-Alder adducts tentatively identified as $CF_2ClCFClNOCH_2CH=CHCH_2$ and $CF_2ClCFClNOCH_2C(CH_3)=C(CH_3)-CH_2$. (auth)

20644 (NP-10264(p.61-7)) OXIDATION STATES OF U, Np, AND I IN NUCLEAR BOMB DEBRIS. E. C. Freiling (Naval Radiological Defense Lab., San Francisco).

The probable oxidation states of I, Np, and U in sea water are discussed, and experimental data on the oxidation state distribution of I^{131}, Np, and U after underwater bursts are presented. The results indicate that, at early times, the higher oxidation states of I^{131}, Np, and U are more abundant in the aqueous phases of fall-out samples than the lowe oxidation states. However, there is evidence of reducing action by the sea water, particularly in the case of I^{131} (D.L.C.)

20645 (NRL-5465) THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES. R. R. Miller and V. R. Piatt, eds. (Naval Research Lab., Washington, D. C.). Apr. 21, 1960. 167p.

The past and present research and development effort of the U. S. Naval Research Laboratory on the atmospheric habitability of submarines is reviewed. Early developments in foreign navies are discussed, followed by the convergence of most of the U. S. research effort affecting atmospheric habitability of nuclear-powered submarines at NRL. Topics covered include atmospheric sampling, analysis and monitoring, the generation of oxygen, and the removal of unwanted components such as carbon monoxide, carbon dioxide, hydrogen, organic contaminants, and aerosols. Emphasis is given to methods of preventing the gradual buildup of contaminants capable of decreasing the efficiency of the crew or of having deleterious effects on delicate or critical equipment. The direction for future research and development is presented, including cooperative effort by the Bureaus of the Navy. (auth)

20646 (PAN-209/IV) THE EXTRACTION OF INORGANIC COMPOUNDS BY MIXED EXTRACTANTS. I. STUDIES ON THE SYSTEM: URANIUM AND CHROMIUM–SULPHURIC ACID–TRI-N-OCTYLAMINE–ALKYLPHOSPHORIC ACIDS–DILUENT. C. Deptuła and S. Minc (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw and Warsaw. Univ.). Dec. 1960. 19p.

A study was made of the extraction of uranyl sulfate and potassium dichromate by tri-n-octylamine, and alkylphosphoric acids (MBP, DDPA, DBP, TBP) solutions in carbon tetrachloride, benzene and nitrobenzene. It was found that two phenomena are involved namely, synergism and antagonism. The occurence of these phenomena depends on the concentration of sulfuric acid solutions used in the extraction study. Tri-n-butylphosphate, in contrast with mono- and di-butylphosphate acids, shows no influence on the extraction of potassium dichromate by tri-n-octylamine solutions. (auth)

20647 (PAN-213/VIII) SEPARATION OF URANIUM AND RARE-EARTH ELEMENTS FROM ETHYLENEDIAMINETETRAACETIC ACID SOLUTIONS ON ION-EXCHANGE RESIN. I. Krawczyk (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1961. 24p.

A method of analytical separation of traces of rare-earth elements (of the order of 10^{-5} g and less) from uranium has been elaborated. The solution containing uranium, lanthanides and disodium salt of ethylenediaminetetraacetic acid is passed through a column with cation-exchange resin Amberlite IRC-50 in sodium form. Uranium is adsorbed on the ion-exchange resin, and rare earth elements appear in the effluent. The order of magnitude of the error with regard to the separation of lanthanides has been estimated as several per cent. (auth)

20648 (TG-331-7) TASK R. QUARTERLY PROGRESS REPORT NO. 7 FOR THE PERIOD OCTOBER 1–DECEMBER 31, 1960. (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). 42p.

High Temperature Chemical Kinetics in Laminar Flames. The approach taken in this project is to obtain high temperature chemical kinetic information by means of the detailed analysis of laminar flame structure. Work continued on developing a scavenger probe technique for H-atoms. Thermal Conductivity of Gases by a New Technique. Extension of a method previously developed for the accurate measurement of high temperature molecular diffusion coefficients to the measurement of thermal conductivity is being attempted. A hot wire anemometer previously developed was set up for absolute velocity measurement and appeared to work well up to 800°K. Transport Property Studies in Dissociated Gases. Methods of measuring diffusion coefficients and thermal conductivity in gases composed on labile atoms and their present molecules are being explored. Preliminary experience with a thermocouple catalytic atom detector is described. Pt–Rh thermocouples appeared promising for the use with H-atoms, while the same couples coated with Ag for better catalytic efficiency were somewhat erratic with O atoms. Additional theoretical work on the problem of diffusion and reaction in a Poiseuille flow reactor was done. Rocket Nozzle Fluid Dynamics. The purpose of this project is to apply the results of Task R and other research to an analytical study of the complex chemical kinetics occurring in the flow of real propellant gases through nozzles. Pressure distributions at area ratios 1-3 in the 25° nozzle and 3-36 in the 12.5° nozzle are reported. Further development work with the infrared absorption spectrometer is described, as well as some preliminary observations with a new optical pyrometer. Some results of gas sampling with a physical probe are presented. (auth)

20649 (TID-12798) FOURTH ANNUAL PROGRESS REPORT. PART I. OCTOBER 1, 1960–MARCH 4, 1961. L. K. Huber and A. V. Grosse (Temple Univ., Philadelphia. Research Inst.). Mar. 4, 1961. Contract AT(30-1)-2082. 20p.

A method for preparing rhenohydride $[ReH_4]^-$, by reacting rhenium trichloride with lithium aluminum hydride, was attempted. As is shown, no rhenohydride $[ReH_4]^-$ was formed, but instead under evolution of hydrogen the rhenium trichloride was reduced to metallic rhenium by the lithium aluminum hydride. By heating a mixture of rhenium metal and lithium hydride in an atmosphere of hydrogen up to the melting point of lithium hydride, no reaction or formation of rhenohydride took place. At the reaction of bis(triphenylphosphine)rhenium trichloride with lithiun aluminum hydride under cleavage of the halogen atoms, the rhenium complex was reduced by lithium aluminum hydride. Indirect methods applied to prove the true nature of the compound formed thereby,—i.e., attempts to isolate the pure compound, failed and did not give evidence as to whether besides the reduction, the formation of a rhenohydride had taken place. (auth)

20650 (UCRL-9566) CHEMISTRY DIVISION ANNUAL REPORT, 1960. (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1961. Contract W-7405-eng-48. 332p.

Summaries are given of the activities of the Nuclear Chemistry Division during 1960, in radioactivity and nuclear spectroscopy, fission, nuclear reactions, physical chemistry, instrumentation, and chemical engineering. Included are abstracts of graduate theses awarded during 1960 for work conducted in the Division. (B.O.G.)

20651 TRITIUM AS AN INTERNAL SOURCE OF RADIATION IN EPR STUDIES OF ORGANIC MATERIALS. J. Kroh and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). J. Chem. Phys., 34: 1853-4(May 1961).

Uses of tritiated water as an internal radiation source in electron paramagnetic resonance (EPR) studies of organic materials are outlined. The method is outlined for substances miscible with water, such as methanol, ethanol, and acetone, and for substances immiscible with water, such as chloroform and ethyl ether. The substances immiscible with water are tritiated by rapid condensation of a mixture of T_2O and the organic vapor at ~80°K. The effects of the OH^- radical are noted. (T.F.H.)

20652 PREPARATION OF DOUBLE SALTS OF NIOBIUM AND TANTALUM CHLORIDES. (to CIBA, S. A.). Belgian Patent 588,449. Priority date, Mar. 10, 1959.

Double salts of niobium and tantalum chlorides with halides of alkaline and alkaline-earth metals are prepared by passing the gaseous pentachloride ($TaCl_5$ or $NbCl_5$) over the granulated halide (KCl or KF) in a vertical column at a temperature above the melting point of the double salt which is thus recovered at the bottom of the column. If the lower-valency salts (trivalent niobium or tetravalent tantalum) are to be obtained, the reaction is carried out in a hydrogen atmosphere. (EURATOM)

20653 CHLORINATION OF ZIRCONIA-SILICA COMPOUNDS. Arthur Wallace Evans (to British Titan Products Co., Ltd.). British Patent 868,807. May 25, 1961.

A process for the preparation of zirconium tetrachloride by the action of chlorine at 1050 to 1250°C on a zirconium-silica compound such as zircon is described. The process is maintained in the presence of a reducing agent as a fluidized mass and is followed by a separation of zirconium tetrachloride from silicon tetrachloride. The process is characterized by the introduction of a zirconium-containing additive into the mass, the additive being introduced in an amount such that the weight of the additive in the mass is always less than the weight of the zirconia-silica compound in the mass. The additive reacts highly exothermically with chlorine so that the mass is maintained at the desired high temperature. The reducing agent is petroleum coke. The zirconium-containing additive is zirconium cyanonitride, zirconium nitride, zirconium carbide, zirconium metal, or zirconium metal dross and is added in the amount of 10 to 80%, preferably 25 to 45%, by weight of the zirconia-silica compound. The materials are in powder form with the coke being ground to between 18 and 100 mesh. A plurality of chlorine inlets are provided through the base of the fluidized bed for equal distribution and imposing upon the passage through the block a pressure of one-half to fifty times the pressure drop in passage through the bed. (N.W.R.)

Analytical Procedures

20654 (AFOSR-TR-60-99) A STUDY OF THE CHEMISTRY OF NIOBIUM AND ITS RELATED ELEMENTS. Final Report. James L. Kassner (Alabama. Univ., Tuscaloosa). July 31, 1960. Contract AF(600)-1567. 14p. (AD-251857)

A spectrophotometric method for determining rhenium is outlined which uses 4-methylnioxime and which is applicable in the concentration range of <0.001% to >1.0% rhenium in molybdenite. Interfering elements are removed in this method. (D.L.C.)

20655 (BM-RI-5801) REPRODUCIBILITY OF TRITIUM ANALYSIS OF ORGANIC COMPOUNDS USING A LIQUID SCINTILLATION SPECTROMETER. Marvin L. Whisman, Barton H. Eccleston, and F. E. Armstrong (Bureau of Mines. Bartlesville Petroleum Research Center, Okla.). July 1960. 17p.

Several parameters controlling the reproducibility of tritium determination in organic compounds by liquid scintillation counting were evaluated by the Federal Bureau of Mines. These included optimum volume of scintillator solution for maximum counting efficiency, reproducibility of counting a sealed commercial standard, and comparison with duplicate counts on laboratory-prepared samples. The error introduced by using microliter pipets, optical differences in counting vials, reproducibility of counting organic samples where quenching is a factor, reproducibility of counting laboratory-prepared samples with an added internal standard, optimum ratio of internal standard activity to sample activity, effect of sample volume upon counting efficiency, count rate at which coincidence losses become apparent, and reproducibility of organic compound radioassay by the standard addition technique are outlined. From the evaluation of these parameters, a technique that can be applied routinely to organic compounds containing tritium has been established, and details are included. (auth)

20656 (CEA-1821) ANALYSE ISOTOPIQUE DE L'URANIUM PAR SPECTROMETRIE α. (Isotopic Analysis of Uranium by α Spectrometry). Jeanine Olkowsky and Leon Cohen (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 11p.

If the α spectra of the separated isotopes of natural uranium are known, the isotopic abundance of a sample of enriched uranium can be deduced. The α spectra are obtained by the pulsed ionization chamber method. α spectrometry is of particular interest for all measurements where the influence of U^{234} may be neglected. (auth)

20657 (CF-61-5-118) DETERMINATION OF TRACER ELEMENTS IN WATER BY NEUTRON RADIOACTIVATION ANALYSIS. G. W. Leddicotte and D. W. Moeller (Oak Ridge National Lab., Tenn.). May 29, 1961. 32p.

Investigations conducted at Oak Ridge National Laboratory in the application of neutron radioactivation analysis to the determination of trace elements in water are reported. The methods employed to irradiate the samples, the post-irradiation processing techniques, and the radioactivity measurements used to complete an analysis are discussed. In addition, some speculations on the future place of this unique analysis method in water chemistry are made. (auth)

20658 (CNI-47) APPARECCHIATURA PER IL DEGASAGGIO DELLE SOLUZIONI ACQUOSE E PER LA RACCOLTA E MISURA DEI GAS ESTRATTI. (An Apparatus for Degassing Water and Collecting and Measuring Extracted Gases). A. Colombo (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). [nd]. 15p.

A method of degassing and measuring permanent gases in water is described, which utilizes a mercury diffusion pump for extracting and a Toepler pump in series with the diffusion pump for collecting and measuring gases. The Toepler pump may be used as a measuring buret connected with a manometer. (auth)

20659 (CNI-48) ANALISI D_2O/H_2O PER INTERFEROMETRIA. (Analysis of D_2O/H_2O By Interferometer). B. Versino (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). [nd]. 14p.

Analyses were made of samples of H_2O enriched with D_2O up to 0.1% by interferometer using the compensation method. Apparatus, accuracy, and data are reported. (auth)

20660 (CNI-49) DETERMINAZIONE QUANTITATIVA DI DEUTERIO NELL'ELIO DEL REATTORE. (Quantitative Determination of Deuterium in Helium of the Reactor). S. Facchetti (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Aug. 1960.

A method of analysis for small concentrations of deuterium in helium by mass spectrometry is described, based on the reduction of electron energies at a value lower than the ionization potential of helium. Measurements of mixtures of deuterium-helium and deuterium, helium, and air are reported. (auth)

20661 (IDO-14547) ANNUAL REPORT OF ICPP ANALYTICAL SECTION FOR 1960. Ralph C. Shank (Phil-

lips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 14, 1961. Contract AT(10-1)-205. 167p.

The colorimetric Ni, Cr, and Fe methods were revised to use comparison standards rather than calibration curves. A fading end point in the volumetric nickel method was corrected by eliminating the Gooch crucible vacuum filtering step which contaminated the sample with rubber. The fluorophotometric method for uranium was modified by substituting a 2% LiF–98% NaF flux for 100% NaF flux and by improving the fusion apparatus. Organic coolant samples from the OMRE were analyzed for total ash content and iron. Fuel samples from several reactors were analyzed for uranium isotope distribution. Equipment in the Remote Analytical Facility was improved. The determination of Sr^{90} in the presence of Sr^{89}, without the long wait for 64-hr Y^{90} equilibrium by the use of B energy discrimination is being evaluated. Gas samples from reactor operations were analyzed. Irradiated fuel specimen samples were analyzed for Cs^{137}. Heavy water was analyzed for D_2O concentration by pycnometric methods. The amount of oil in the water was also determined. Water samples from loop experiments were analyzed for boron by the carminic acid spectrophotometric method. A spectrophotometric procedure for the determination of tin was developed based on the blue tin (IV)-pyrocatechol complex formed in a gelatin–acetate buffered media. Various plant streams were analyzed for total plutonium content. Mercury samples were studied for determination of microgram levels of iron. Analytical methods developed for analysis of aluminum alloys used for fuel elements are described. Cellulube lubricants were analyzed for trace quantities of chloride. The surface ionization efficiency of uranium efficiency from a tantalum ribbon in the mass spectrometer source was improved. The applicability of the surface ionization technique for isotopic measurements was investigated. Equipment was provided for the recovery of fission gases from experimental fuels. A facility for handling radioactive samples for analysis with the emission spectrometer was designed. A recording comparator-microphotometer was installed. A method was developed for the determination of beryllium in air from filter paper samples. Development work was continued on a hollow cathode discharge tube as a high resolution source for the isotopic analysis of uranium and americium. An analytical method for lead in solutions containing macro amounts of uranium and zirconium was developed. Impurity elements were determined in samples of radioactive hafnium from reactor control rods. X-ray fluorescence analysis by the active dilution method and x-ray absorption analysis are described. An investigation was made of the infrared absorption of nitric and nitrous oxides. Infrared spectrophotometry was used for the determination of D_2O in heavy water. A series of U^{233} and U^{235} solutions in HNO_3 media, prepared to evaluate η, were analyzed by coulometric methods. Two potentiostats were constructed. A program is under way for evaluation of fluidized bed calcination for disposal of radioactive waste. Measurements were made of bulk density, absolute density, and particle density. A method was developed for determination of particle size distribution. A solvent extraction method for the determination for cerium was developed. Methods for the determination of Mo, Tc, Te, and I in waste tanks are discussed. The determination of plutonium and uranium in power reactor fuel dissolver samples is discussed. A study is being made of lower molecular weight quaternary amines to produce separation methods for metals. The feasibility of nuclear magnetic resonance for determining fluoride in zirconium fuel dissolver solutions is being evaluated. Several colorimetric procedures for the determination of micro amounts of fluoride are compared. Requirements of a lithium compound for use in alloying with aluminum–uranium fuel were determined. A method was developed for the separation of lithium from alloys. The oxlate complexing method for the determination of free acid in samples containing hydrolyzable ions was found to give high acid bias for samples that contained polymerized zirconium hydroxy species. Complexometric methods were developed for determination of cadmium and lead and for the determination of rare earths in alloys with high-purity aluminum. A method based on the sensitive blue complex formed with 1,1′-dianthramide was adapted for determining boron in alloys of uranium and aluminum. A titrimetric method for the determination of uranium in alloys with aluminum was evaluated. A procedure based on the methyl isobutyl ketone extraction of uranium(VI) trinitrate and a direct absorbance measurement of the organic phase was adapted for determination of U(IV) and (VI) in mixtures. A tracer technique was developed to establish concentration gradient profiles in a pilot plant evaporator. A colorimeter was modified for narrow absorbance peak measurements in the determination of uranium. Reflux dissolvers and associated apparatus were designed and installed in the Remote Analytical Facility. Construction was begun on a facility for analysis of alpha-beta-gamma active samples. The comprehensive quality control program on all routine methods was continued. Appendices containing lists of publications, reports, papers, and methods added to the ICPP Analytical and Analytical Radiochemical Manuals are included. (M.C.G.)

20662 (NCL/AE-198) THE DETERMINATION OF MICROGRAM QUANTITIES OF URANIUM IN SOME BERYLLIUM MATERIALS. G. H. Smith and D. C. Havard (Gt. Brit. National Chemical Lab., Teddington, Middx., England). Sept. 1960. 20p.

Variants of the fluorometric method for determining trace quantities of uranium in beryllium and beryllium-containing materials were investigated. Break-down or dissolution of samples and separation of uranium by solvent extraction for subsequent fluorimetric measurements were studied. Results are presented for a number of methods used with various beryllium materials. The details of the method used are determined to some extent by the nature of the sample. (D.L.C.)

20663 (NP-10330) SURVEY OF METHODS USED IN THE ANALYSIS OF REFRACTORY METALS. (National Research Council. Materials Advisory Board). [1960]. 59p.

The results of a survey of analytical techniques for refractory metals and their alloys are presented in the form of tables of techniques used to analyze various metals for alloying constituents, interstitial elements, and impurities. Problems encountered in these techniques are discussed. (D.L.C.)

20664 (PAN-205/VIII) DETERMINATION OF GALLIUM AND INDIUM BY THE NEUTRON ACTIVATION METHOD. H. Jaskolska and J. Minczewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 17p.

A method was derived for the determination of trace amounts of Ga and In by neutron activation analysis. After irradiation with thermal neutrons at 3×10^{11} n/cm^2 · sec., the samples containing Ga and In were treated with NaOH, the hydroxides were centrifuged and dissolved in HCl. Ga and In were extracted from the HCl-solution with acetylacetone at pH = 3 and after reduction with hydroxylamine hydrochloride Ga was separated by ether extraction. In was

separated by ether extraction from the HBr and HI solution. Both elements were determined by the use of 8-hydroxyquinoline and the β-activities of them were measured. The per cent of extraction was determined with acetylacetone of Ga, In, and 14 other elements from the HCl-solution at pH = 3. The detectability of Ga and In was 1.2×10^{-8} g and 3.3×10^{-8} g, respectively. Average error was ±10%. (auth)

20665 (USNRDL-TR-485) QUANTITATIVE RADIOCHEMICAL ANALYSES BY ION EXCHANGE. SODIUM AND CESIUM. L. Wish (Naval Radiological Defense Lab., San Francisco). Nov. 29, 1960. 14p.

A method was developed for the carrier-free separation of sodium and cesium radionuclides from a mixture of alkaline earth and rare earth fission products. The activities are adsorbed on a Dowex-50 cation column from 0.1N hydrochloric acid solution. The sodium is eluted with 0.25 M sodium chloride and cesium with 0.50 M ammonium chloride solution. Results are given for the separation of the cesium from fission mixtures obtained from neutron-irradiated U^{235} samples. (auth)

20666 (CEA-tr-R-1026) DOSAGE SPECTROMETRIQUE DES ELEMENTS DES TERRES RARES EXTRAITS DES ROCHES. (Spectrometric Determination of Rare Earth Elements Separated from Rocks). A. N. Zaidel, E. N. Fafurina, P. P. Yakimova, and S. S. Yakovleva. Translated into French from Vestnik Leningrad. Univ., 15: No. 4, Ser. Fiz. i Khim., No. 1, 48-59(1960). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 7300.

20667 (NP-tr-607) GEOCHEMISTRY. VII. TREATMENT PLANT FOR TRITIUM IN NATURAL WATER. E. Schumacher. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment) from Helv. Chim. Acta, 43: 1019-32(1960). 32p.

A treatment plant for determination of tritium is described. It was used primarily for determining the age of glacial snow and ice in the Greenland ice cap. Electrolysis was chosen as the method for enriching samples in tritium. An electrolytic unit for processing of samples simultaneously is described. The individual electrolytic stages and the processing steps are given. Calibration measurements and sources of error are discussed. (M.C.G.)

20668 DETERMINATION OF C^{14} AND H^3 IN BIOLOGICAL SAMPLES BY SCHÖNIGER COMBUSTION AND LIQUID SCINTILLATION TECHNIQUES. R. G. Kelly, E. A. Peets, S. Gordon, and D. A. Buyske (Lederle Laboratories, Pearl River, N. Y.). Anal. Biochem., 2: 267-73(June 1961).

The Schöniger combustion technique was adapted for the preparation of biological samples containing tritium and carbon-14 for liquid scintillation counting. A combustible sample holder made of dialysis tubing permits the efficient drying of biological tissues and homogenates prior to combustion. Following combustion, CO_2 is absorbed in a Hyamine hydroxide solution which is then dissolved in a toluene phosphor. Tritiated water is collected as ice which is dissolved in a toluene–ethanol phosphor. A recovery of 96 ± 6% was obtained for a series of 25 determinations of carbon-14 added to various biological samples. A similar experiment involving 30 determinations of added tritium gave results of 96 ± 5% recovery. The method employs inexpensive and readily available apparatus. 50 determinations can be carried out by one individual in an 8-hr period. (auth)

20669 THE DETERMINATION OF DEUTERIUM IN BIOLOGICAL FLUIDS. Henry L. Crespi and Joseph J. Katz (Argonne National Lab., Ill.). Anal. Biochem., 2: 274-9(June 1961).

Spectrophotometric methods for the analysis of deuterium in biological fluids are described. The methods cover the entire range from 0 to 100 at.% D_2O, and micro amounts of sample may be analyzed directly. Results obtained with urine, serum, distillate, and water of combustion samples are presented. (auth)

20670 FLAME-PHOTOMETRIC DETERMINATION OF LITHIUM IN SILICATE MINERALS. J. Liebig and H. Bredehorst (Forschungslabor für anorganische Chemie des VEB Elektrochemisches Kombinat Bitterfeld, Ger.). Anal. Chim. Acta, 24: 573-5(June 1961). (In German)

The determination in Zinnwaldit-concentrates was carried out after removal of the interfering elements (Fe, Al, Mn, Ca, K, Na, etc.) either by means of cation and anion-exchange resins or by means of CdO or basic lead carbonate. Flame photometry alone resulted in up to 8% too high lithium values. (auth)

20671 CHELATES OF 4-HYDROXYBENZOTHIAZOLE WITH THE RARE EARTHS. Pao-Kuo Feng and Quintus Fernando (Univ. of Pittsburgh). Anal. Chim. Acta, 24: 548-54(June 1961). (In English)

The rare earth chelates of 4-hydroxybenzothiazole were prepared and analyzed by titrimetric and microgravimetric methods. The infrared spectra of these chelates were determined. (auth)

20672 CHEMICAL AND RADIOCHEMICAL ANALYSIS OF RADIOACTIVE ATMOSPHERIC DUSTS. V. Mageru, I. Gabe, and D. Blanariu. Analele stiint. univ. "Al. I. Cuza" Iasi, Sect. I, 5: 119-30(1959).

A scheme of analysis for small quantities of atmospheric dust of low radioactivity is presented, involving the addition of entrainers followed by chromatography and measurement of the activity of the separated spots. The air is filtered, the dust is washed from the filter with H_2O and the washings are evaporated to dryness and ignited at 400 to 500°C. The weighed residue is evaporated with HF to remove SiO_2 and dissolved in HCl (and HNO_3 if necessary). The solution is treated with 50 μg each of Ce^{3+}, La^{3+} and Zr^{3+} as "entrainers of retention" and 75 μg each of Sr^{2+} and Cs^{+} as entrainers, and evaporated to 1 ml. An aliquot (0.25 ml) is chromatographed on Whatman No. 3 paper for 18 hr at 20° with ethanol–butanol–acetic acid (2 : 1 : 1). Two procedures are described for the identification of the isotopes. (auth)

20673 EFFECT OF CHEMICAL PURITY ON THE NUCLEAR PROPERTIES OF GRAPHITE. J. Rappeneau and M. Yvars. Bull. inform. sci. et tech. (Paris), No. 48, 37-44(Feb. 1961). (In French)

The utilization of artificial graphite as a moderator is due to its low capture cross section. However, the presence of certain impurities, even as traces elements, can increase considerably the values of the capture cross section. The methods used for the determination of B, Na, Li, Mg, V, Fe, Mo, Ti, Cl, and H are briefly described, and the methods used for the rare earths Dy, Eu, and Sm are indicated. These methods of determination were used to follow the production of graphite for G-1, G-2, EDF-1, and EDF-2. The principal correlations existing between the capture cross sections and the concentrations of some elements, determined during production, are described. The effect of the quality of the primary material and the efficiency of the procedures of chemical treatment during graphitization are emphasized. (tr-auth)

20674 PHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF COBALT IN STAINLESS STEEL. Shizo Hirano, Atsushi Mizuike, Yoshio Iida, and Nobuhiko Koku-

bun (Tokyo Univ.). Bunseki Kagaku, 10: 326-30(Apr. 1961). (In Japanese)

A method is described for the photometric determination of microgram quantities of cobalt in stainless steel. An 8N HCl solution of the sample is shaken with a 2:1 mixture of methyl isobutylketone and amyl acetate to remove iron. The aqueous layer is then introduced into an anion exchange resin column to remove nickel and chromium. Cobalt is desorbed from the column with 2.5N HCl and determined by the photometric nitroso-R salt method. Experiments using Co^{60} and synthetic sample solutions indicate that cobalt in stainless steel can be determined by this method within an accuracy of 5 to 10% in the range of 0.0001 to 0.2%. The time required for a determination is approximately 2 to 3 hours. (auth)

20675 PHOTOMETRIC METHOD FOR DETERMINING A SMALL AMOUNT OF ZIRCONIUM IN IRON AND STEEL BY USING PYROCATECHOL VIOLET. Shizuya Maekawa, Yoshio Yoneyama, and Eiichi Fujimori (Muroran Plant, Japan Steel Works, Ltd.). Bunseki Kagaku, 10: 341-5(Apr. 1961). (In Japanese)

A simple and accurate absorption photometric method for determining a small amount of zirconium in iron and steel was devised; the method employs pyrocatechol violet. When the sample is decomposed with perchloric acid and reduced with sodium bisulphite, zirconium is coprecipitated with a small amount of iron as cupferrate. This precipitate is decomposed by nitric acid and perchloric acid. After ethylenediamine tetraacetic acid is added, the pH is adjusted to 5.0 by the use of an acetate buffer solution. It is colored by adding pyrocatechol violet, and the light absorbancy is measured at 575 mμ against the blank. When iron is previously separated by the ether extraction or mercury cathode electrolysis methods for a sample having a high content of arsenic or phosphorus, a portion of zirconium will be lost, giving a too low value. (auth)

20676 COLORIMETRIC RAPID DETERMINATION OF SILICON IN COPPER-BERYLLIUM ALLOYS. Katsuzo Kida, Mitsunobu Abe, Susumu Nishigaki, and Takeshi (Nippon Gaishi Co., Ltd.). Bunseki Kagaku, 10: 358-62 (Apr. 1961). (In Japanese)

Rapid determination of silicon in Be-Cu alloys is studied by a colorimetric molybdenum blue method. The sample is dissolved by H_2SO_4 (1:6) and H_2O_2, and heated to decompose the H_2O_2. After dilution, a 10% ammonium molybdate solution is added. After 5 min, 4% HF and 30% ferrous ammonium sulfate solutions are added. The absorption of molybdenum blue is measured at 750 mμ. The time required for an analysis is about 20 min. (auth)

20677 SPECTROPHOTOMETRIC DETERMINATION OF A MICROAMOUNT OF TITANIUM IN NIOBIUM WITH HYDROQUINONE. Masao Kawahata, Heiichi Mochizuki, and Takeshi Misaki (Nippon Yakin Kogyo Co., Ltd., Kawasaki, Japan). Buneseki Kagaku, 10: 502-8(May 1961). (In Japanese)

Titanium, coprecipitated with Nb was dissolved in H_2SO_4 and developed a coloration with hydroquinone. The light absorbancy of H_2SO_4 solution of hydroquinone complexes of Nb, W, and Ti which changed with the concentration of H_2SO_4 was measured at different wavelengths. The solution, made up to 100 ml with hydroquinone-sulfuric acid solution, hardly showed the sign of complex formation, and the light absorbancy at wavelength longer than 400 mμ was very slight for Nb and W, when 30 ml and 35 ml (or more) of water had been added previously to their solution, respectively. The light absorbancy of Ti complex at 480 mμ gave practically no change even with addition of 0 to 40 ml water, but it was affected at the other wavelengths. This determination was not influenced by the presence of 3 mg Nb and 1.5 mg W. Above this disturbing influence was shown. The lower limit of determination of Ti by this method was 0.01 mg/100 ml. (auth)

20678 MICRODETERMINATION OF DEUTERIUM IN ORGANIC SUBSTANCES. J. Horáček (Inst. of Organic Chemistry and Biochemistry, Czechoslovakia Academy of Sciences, Prague). Collection Czechoslov. Chem. Communs., 26: 772-80(Mar. 1961). (In German)

A new simple rapid method for the combustion of organic deuterium-containing compounds was worked out which makes possible the direct obtention of water. The water is suitable for isotopic analysis by the falling drop method without further purification. The decomposition products of silver permanganate at 500°C were used as oxidation catalysts and decomposition products of potassium permanganate at the same temperature were used for the quantitative absorption of nitrogen in the combustion chamber. By decreasing the dimensions of the combustion chamber, a contamination reduction was obtained. The thermostat, which maintains the temperature of the bath with an accuracy of ±0.001° at a constant height, is described. (tr-auth)

20679 COLLECTING $C^{14}O_2$ IN A WARBURG FLASK FOR SUBSEQUENT SCINTILLATION COUNTING. Fred Snyder and Paul Godfrey (Oak Ridge Inst. of Nuclear Studies, Tenn.). J. Lipid Research, 2: No. 2, 195(Apr. 1961).

An improved technique for the collection of $C^{14}O_2$ in a Warburg flask and for the subsequent transfer of the radioactive material for liquid scintillation assay is described. A high-molecular-weight quaternary amine is used for absorbing the radioactive carbon dioxide. The absorbant is injected into the center well or side arm of the flask, then sulfuric acid is poured into the main compartment to release the carbon dioxide from the solution, bicarbonate buffer gassed with 95% O_2, 5% CO_2, C^{14}-labeled substrate. After shaking for 3 hrs at 37°C, the material is transferred to a glass counting vial that contains a toluene mixture, and the radioactive content is measured by a liquid scintillation spectrometer. (N.W.R.)

20680 CALIBRATION PROCEDURE FOR THE MEASUREMENT OF RADIOACTIVE AEROSOL CONCENTRATION WITH THE FILTER METHOD. Karl-Heinz Weber and Wolfram Wisch. Staub, 20: 393-8(Nov. 1, 1960).

The measurement of radioactive aerosol concentration by enrichment with the aid of fibrous filters is described. Calibration can be carried out with the aid of surface preparations of known and homogeneously distributed activity and of a filter of similar absorption behavior with the same geometry. In the evaluation the differences in self-absorption caused by the exponential dust deposition in the filter must be taken into consideration. The corresponding correction factors are calculated as a function of the energy and of the collection efficiency and surface density of the filter. An experimental method is given for estimating the effective particle energies. (auth)

20681 SEPARATION AND DETERMINATION OF SCANDIUM USING N-BENZOYLPHENYLHYDROXYLAMINE. I. P. Alimarin and Yun-Syan Tsze (Yung-Schaing Tze) (Moscow State Univ.). Talanta, 8: 317-21(May 1961). (In English)

Scandium may be determined using N-benzoylphenylhydroxylamine, which precipitates a complex containing scandium and reagent in the ratio 1:3. This precipitate may be utilized for the gravimetric determination of

scandium by conversion to Sc_2O_3 at 600°C. It is possible to separate scandium from zirconium, titanium and the rare earth elements by extraction. (auth)

20682 ACTIVATION ANALYSIS OF MANGANESE IN CAST IRON AND HIGH-ALLOY STEELS. P. Bouten and J. Hoste (Ghent Univ.). Talanta, 8: 322-9(May 1961). (In English)

An activation method for the determination of manganese in cast iron and high-alloy steels is developed. Self-shielding errors and neutron flux irregularities are avoided by the use of an internal standard. Two procedures, integral counting and pulse height discrimination, are used. The method is tested on standard samples. The results obtained on samples with a widely differing composition are in agreement with those obtained by classical chemical analysis. (auth)

20683 THE DETERMINATION OF TRACES OF IRIDIUM IN SAMPLES OF RHODIUM BY NEUTRON-ACTIVATION AND GAMMA-RAY SPECTROMETRY. D. F. C. Morris, D. N. Slater, and R. A. Killick (Brunel Coll. of Tech., London). Talanta, 8: 373-6(June 1961).

The Harwell Pile BEPO was used as the neutron source. The method involved irradiation of samples and standards and their subsequent γ-spectrometric assay; no radiochemical separations were required. (auth)

20684 SEPARATION AND COLORIMETRIC DETERMINATION OF TRACE QUANTITIES OF MAGNESIUM IN HIGH-PURITY BERYLLIUM OXIDE. R. F. Apple and J. C. White (Oak Ridge National Lab., Tenn.). Talanta, 8: 419-25(June 1961).

Beryllium is separated from the Mg by forming the beryllium perfluorobutyrate salt at pH 3 to 4, and then extracting it with several portions of diethyl ether. By increasing the number of equilibrations with ether, as much as 1 g of Be can be separated from 10 μg of Mg. The Mg is then measured spectrophotometrically as the highly colored complex with Magon, sodium 1-azo-2-hydroxy-3-(2,4-dimethylcarboxanilido) naphthalene-1-(2-hydroxy-benzene-5-sulfonate), which exhibits a peak of maximum absorbance at 510 mμ. Over the range of 0·04 to 0·40 μg of Mg per ml, the absorbance conforms to Beer's law. The method was applied successfully to the determination of quantities of Mg as low as 10 μg. The coefficient of variation for samples which contain 200 μg of Mg is 2%. (auth)

20685 THE RAPID MEASUREMENT OF TOXIC GASES AND VAPORS. Tetsuzo Kitagawa (Yokohama National Univ., Japan). p.506-12 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Detection tubes are described for use in the rapid determination of small quantities of toxic gases and vapors. The detection tubes are composed of a glass tube packed with fine grains of purified silica gel or glass impregnated with chemical reagents having a characteristic color reaction with a specific gas. When the ends of the tubes are cut off and the sample gas or air is drawn through the tube a color change is produced from which the concentration of the gas can be determined. The selection of a suitable chemical reagent is very important. Factors which may influence accuracy are discussed. The method is said to be applicable for purposes of industrial hygiene, public health, mine safety, process control, and in monitoring industrial waste waters. Data are tabulated on color changes of reagents in the presence of a number of gases. (C.H.)

20686 COPRECIPITATION OF RADIOACTIVE ELEMENTS WITH ORGANIC AGENTS. APPLICATION OF THE METHOD TO THE DETERMINATION OF URANIUM TRACES BY UV SPECTROPHOTOMETRY. A. Lo Moro, L. Pucini, and L. Rigali (C.A.M.E.N., Leghorn). p.477-87 of "VII Rassegna Internazionale Elettronica e Nucleare. V. Congresso Nucleare 1960. Volume Secondo." Rome, Comitato Nazionale Ricerche Nucleari, [1960]. (In Italian)

Microquantities of uranium in solution are separated by coprecipitation with organic agents. The coprecipitation permits the separation of uranium with concentrations as low as 0.1 mg/l. The subsequent determination of the uranium is carried out by uv spectrophotometry of the U–HCl complex formed by the dissolution of uranium in concentrated HCl. (tr-auth)

20687 DETECTION OF CONTAMINATION IN CHANNELS OR CONDUITS BY MEANS OF SOLUTIONS CONTAINING RADIOACTIVE ISOTOPES. (to S. A. Diversey). Belgian Patent 587,881.

A tracer-gamma emitting compound is circulated through pumps, conduits and containers used in the food industry and vulnerable to bacterial contamination. This compound includes: sodium iodide labeled with radioactive iodine-131; an alkaline metal carbonate, sulfate, or tripoly-phosphate which precipitates the isotope upon the contamination; and a wetting agent made of sodium dodecyl-benzene sulfonate and sodium sulfate, which prevents retention of the isotope on non-contaminated surfaces. (EURATOM)

General Inorganic and Physical Chemistry

20688 (AD-237004) NUCLEAR AND ELECTRON SPIN RESONANCE. Final Report. John E. Wertz (Minnesota. Univ., Minneapolis). Feb. 29, 1960. 72p. Contract AF18 (600)-479.

A summary of work is given on the major contributions made in nuclear and electron spin resonance. Nuclear magnetic resonance studies are reported for hydrogen, fluorine, chlorine and free radicals. Electron spin resonance studies on magnesium oxide show that a detailed description of many of the known types of defect centers may be obtained. (W.L.H.)

20689 (AEC-tr-4632) PURIFICATION OF THE HEAVY WATER OF REACTORS EL1 AND EL2 BY ION EXCHANGE RESINS. J. Chenouard and E. Roth. Translated by Myra Scott (Savannah River Lab.) from Sections IV-VII, p.10-22 of Report CEA-673A. 1957. 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 4239.

20690 CEA-tr-X-235) ABSORPTION DANS L'INFRAROUGE PAR LES CHARBONS OXYDES A L'AIR. ABSORPTION A 5,88 μ. (Absorption in the Infrared by Carbon Oxides in Air. Absorption at 5.88μ). Fujii. Translated into French from Kogyo Kagaku Zasshi, 62: 1574-7(1959). 18p.

The infrared absorption spectra were measured for four kinds of carbon of different degrees of graphitization and for these same carbons after air oxidation. The results indicate a mechanism for oxidation of C in air. Oxidation causes a band to appear at 5.88μ. The spectral variations observed during treatment of the carbon oxide by Grignard reagent or KOH show that the absorption at 5.88μ is principally due to a carboxyl group formed by oxidation. A linear relation exists between the total O content and the absorp-

ion coefficient at 5.88μ for each carbon. One can determine the number of C atoms eliminated by oxidation from the slope of the line or by chemical analysis. It was found that the number of C atoms eliminated by oxidation decreases as the degree of graphitization increases. This means that the length of the side chains decreases with graphitization. (tr-auth)

20691 THE SOLVENT EFFECT IN ABSORPTION SPECTRA OF URANYL NITRATE. B. Jeżowska-Trzebiatowska and A. Bartecki (Technical Univ., Wrocław, Poland and Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon sci., Sér. sci. chim., 9: 87-90(1961). (In English)

The influence of solvents on the absorption spectra of uranyl nitrate in the visible range is to be ascribed to the changes in energy of vibrational transitions, intensity of bands, and vibrational structure of the electronic spectrum. For the first and second mentioned changes the general complexing tendency should be considered, while the last change may be connected with the influence of the type of bonding between UO_2^{2+} and solvent molecules. In connection with the last interaction the following types of absorption spectra of uranyl nitrate are discussed: those with completely or almost blurred vibrational structure, with marked diffuse vibrational structure accompanied by an increase of the extinction coefficient for the maximum and total oscillator strength, with partially diffuse structure in the range beginning with 24000 cm^{-1}, and with very distinct vibrational structure. (N.W.R.)

20692 INTERACTIONS OF HEAT TRANSFER GASES WITH GRAPHITE. F. M. Lang, P. Magnier, and S. May. Bull. inform. sci. et tech. (Paris), No. 48, 45-54(Feb. 1961). (In French)

A study of the behavior of graphite with respect to heat transfer gases permitted the fabrication to be oriented toward graphite of better quality or adapted to special aims, gave a better understanding of its behavior in reactors, and led to a study of modifications necessary for the obtention of graphite more suited to future reactors. These studies were not limited to oxygen or CO_2, but are applicable to all other gases with nuclear usages (hydrogen was especially studied at Grenoble). The investigations were divided into several parts: engineering study, analysis, study of the effects of impurities, kinetics of reactions, and study of the evolution of the texture and physical properties of the graphite. (tr-auth)

20693 FORMATION OF AN AMALGAM OF ACTINIUM AND THE QUESTION OF BIVALENT ACTINIUM. Georges Bouissières, Moïse Haissinsky, and Y. Legoux (Laboratoire Curie, Paris, and Laboratoire de Physique Nucléaire, Orsay, France). Bull. soc. chim. France, 5: 1028-30(May 1961). (In French)

It is shown that actinium forms an amalgam with a yield of more than 95%, principally by the action of a lithium amalgam on a citric solution of the element with a pH between 1.7 and 6.8. This behavior, compared with that of La, Nd, Sm, Eu, Gd, and Ho places Ac between Sm and Eu where the strong tendency to the formation of amalgams appears to be connected with the existence of a bivalent state of the two elements. (tr-auth)

20694 TERBIUM OXIDES. III. X-RAY DIFFRACTION STUDIES OF SEVERAL STABLE PHASES. N. C. Baenziger, H. A. Eick, H. S. Schuldt, and L. Eyring (State Univ. of Iowa, Iowa City). J. Am. Chem. Soc., 83: 2219-23(May 20, 1961).

A previous study involving tensiometric measurements, differential thermal analysis, and cursory x-ray diffraction analysis revealed intermediate stable phases in the terbium-oxygen system between the sesquioxide and the dioxide. Previously, many observations of a brown higher oxide of terbium had been made and the formula Tb_4O_7 had been given to it. Work done in these Laboratories, however, failed to reveal any special stability for a composition $TbO_{1.75}$, and it is believed to arise from a slow oxidation of a lower oxide when the latter is cooled in air or oxygen. The present work was undertaken to clarify the various stable phases existing in this oxide system using previous work as a guide in sample preparation. (auth)

20695 CHELATE STABILITIES OF CERTAIN OXINE-TYPE COMPOUNDS. II. 4-HYDROXYBENZOTHIAZOLES. T. J. Lane, C.S.C., and A. Sam (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 83: 2223-5(May 20, 1961).

The acid dissociation constants of 4-hydroxybenzothiazole, 2-amino-4-hydroxybenzothiazole, 2-methylamino-4-hydroxybenzothiazole, and 2-amino-4-hydroxy-7-methylbenzothiazole were determined in 50% v/v p-dioxane at 25° and the chelate stability constants of the ligands with Cu(II), Pb(II), Ni(II), Co(II), Zn(II), and Cd(II) were obtained by Calvin-Bjerrum potentiometric titration technique. The results were compared with those previously reported for 8-hydroxyquinoline, 4-hydroxybenzimidazole, and 4-hydroxybenzoxazole. The stability constants of the 4-hydroxybenzothiazole chelates are lower than those of the corresponding 8-hydroxyquinolinates. This is explained by larger nitrogen-oxygen distance and by unfavorable electron orientation on the donor nitrogen atom. The stability values are higher than those of 4-hydroxybenzimidazoles and 4-hydroxybenzoxazoles and this is attributed to the influence of the larger sulfur atom in the 1-position. (auth)

20696 REMOTE ATTACK AND ESTER HYDROLYSIS ON ELECTRON TRANSFER. R. T. M. Fraser and H. Taube (Univ. of Chicago). J. Am. Chem. Soc., 83: 2239-42(May 20, 1961).

The electron transfer reaction between Cr^{2+} aq and $(NH_3)_5CoL^{2+}$ (where L is the phenyl or methyl half ester of fumaric or terephthalic acid) takes place through attack by the reductant at the carboxyl group remote from the cobalt center. Ester hydrolysis occurs, and the alcohol is found associated with the Cr(III) complex after reaction. Hydrolysis is also found when V^{2+} aq or Eu^{2+} aq are the reductants, but not with Fe^{2+} ($C_2O_4^{2-}$ present), nor is it found with the tris-dipyridyl complexes of V^{2+} and Cr^{2+}, showing that the formation of a bridge complex is a necessary concomitant. Using fumarate or terephthalate as conducting ligands, the nature of the terminal functional group is varied: with $-CONH_2$, $-CONH-CH_3$, $-CHO$, $-CO(C_6H_5)$ remote attack takes place but not with $-SO_2OH$ or $-CON(C_2H_5)_2$. (auth)

20697 ACTIVATION EFFECTS AND RATES OF ELECTRON TRANSFER. R. T. M. Fraser and H. Taube (Univ. of Chicago). J. Am. Chem. Soc., 83: 2242-6 (May 20, 1961).

The isomerization of maleic to fumaric acid which occurs as a result of electron transfer between Cr_{aq}^{2+} or V_{aq}^{2+} and $(NH_3)_5CoL^{2+}$ (where L = hydrogen maleate or methyl maleate) is studied and the ratio of fumaric to maleic acid is found to increase linearly with the hydrogen ion concentration of the solutions. The ester hydrolysis induced in the half ester ligands is shown to involve alkyl-oxygen fission almost quantitatively and aryl-oxygen fission up to 15% rather than the usual acyl-oxygen fission of ester hydrolysis. The specific rate constants for the electron transfer reactions of Cr_{aq}^{2+} and a number of cobalt(III) com-

plexes are measured; those involving adjacent attack show no hydrogen ion dependence and have $k_2 \approx 0.16$ sec^{-1} at 25° ($\mu = 1$). When the ligand L is p-aldehydobenzoate or hydrogen terephthalate, the rate of reaction is too great to be measured. When p-sulfobenzoate and cyclopropane dicarboxylate are ligands, the rates are those characteristic of adjacent attack, and there is no increase in rate with the concentration of hydrogen ion. (auth)

20698 THE KINETICS AND MECHANISM OF THE HYDROLYSIS OF o-CARBOXYPHTHALIMIDE. Burt Zerner and Myron L. Bender (Illinois Inst. of Tech., Chicago). J. Am. Chem. Soc., 83: 2267-74(May 20, 1961).

The kinetics of hydrolysis of phthalmide and of o-carboxyphthalmide are investigated at 100°, the latter both in water and in deuterium oxide. The phthalimide hydrolysis exhibits normal acid- and base-catalyzed reactions. Below pH 1 and above pH 5,o-carboxyphthalimide also exhibits normal acid- and base-catalyzed reactions of comparable magnitude to those of phthalimide. However, in the region from pH 1 to 4, the o-carboxyphthalmide pH-rate profile exhibits a hump (not found in the phthalimide hydrolysis) which indicates the direct participation of the o-carboxy group and a mechanism which is dependent on two protonic equilibria, one of which occurs after the formation of the first tetrahedral intermediate. Three possible mechanisms are suggested and labeled pathways I, II, III: pathway I involves intramolecular nucleophilic catalysis by o-carboxylate ion, pathway II involves intramolecular general basic catalysis by o-carboxylate ion and pathway III involves intramolecular general acid catalysis by the protonated o-carboxyl group. The considerable diminution in the rate of hydrolysis in deuterium oxide ($k^H_{obs}/k^D_{obs} = 2.6$ at pH 3) can be analyzed satisfactorily only in terms of either pathway II or III. Thus steric constraint can transform an intramolecular nucleophilic catalysis (in the hydrolysis of phthalamic acid) into an intramolecular general basic or acidic catalysis (in this system) by prohibition of perpendicular attack at the carbonyl carbon atom. (auth)

20699 RUTHENIUM HEXAFLUORIDE. Howard H. Claassen (Argonne National Lab., Ill.), Henry Selig, John G. Malm, Cedric L. Chernick, and Bernard Weinstock. J. Am. Chem. Soc., 83: 2390-1(May 20, 1961).

Ruthenium hexafluoride is prepared by heating ruthenium metal powder in a fluorine atmosphere at 300 mm pressure in a cylindrical quartz reactor. The solid is dark brown in color, has a transformation at 2.5°, and a fusion point at 54°C. It is unstable and reacts with pyrex glass. Other chemical and spectra data are also presented. (N.W.R.)

20700 DIPOLE MOMENTS OF BISCYCLOPENTADIENYL TITANIUM AND ZIRCONIUM DICHLORIDES. S. A. Giddings and R. J. Best (American Cyanamid Co., Stamford, Conn.). J. Am. Chem. Soc., 83: 2393-4(May 20, 1961).

The high values of the dipole moments, 6.3 and 5.9D, obtained for bis-cyclopentadienyl titanium and zirconium dichlorides, respectively, indicate that there are four essentially equivalent bond angles and that the structure is similar to the $(C_5H_5)_2TiCl_2$ grouping and approaches the tetrahedral configuration. The structure appears to be independent of the oxidation state. The measurements are conducted in benzene using the dielectric constant-refractive index method for both, and the dielectric constant-density method for the first compound. Data are tabularly presented. (N.W.R.)

20701 EFFECTS OF SUBSTITUENTS ON THE RADICAL EXCHANGE REACTION BETWEEN BENZYL IODIDE AND IODINE. Irwin J. Gardner and Richard M. Noyes (Columbia Univ., New York and Univ. of Oregon, Eugene). J. Am. Chem. Soc., 83: 2409-17(June 5, 1961).

The previously unknown compounds p-nitro, p-methyl, and p-methoxybenzyl iodide were prepared. The p-methoxy compound decomposes rapidly in the presence of iodine, but the exchange of elementary iodine with the other two compounds and with unsubstituted benzyl iodide was studied photochemically in ethylene dichloride. The exchange mechanisms are entirely free radical and apparently involve comparable contributions from a direct substitution by iodine atoms and from the abstraction of iodine to form benzyl radičals, although the direct substitution reaction is not established with certainty. Electron-withdrawing substituents accelerate the radical abstraction of iodine, but they slow the abstraction of benzylic hydrogen. Apparently electron withdrawal facilitates radical abstraction of a group that would tend to ionize as a negative entity and depresses radical abstraction of a group that would tend to ionize as a positive entity. In air saturated ethylene dichloride at 30°, oxygen, and 1.4×10^{-4} M iodine compete for benzyl radicals with about equal efficiency. (auth)

20702 THE EFFECT OF ION PAIRING ON THE REACTIVITY OF ANIONIC NUCLEOPHILES. I. THE EXCHANGE REACTION OF *p*-NITROBENZYL BROMIDE WITH BROMIDE ION IN LIQUID SULFUR DIOXIDE SOLUTION. Norman N. Lichtin and K. Narayana Rao (Brookhaven National Lab., Upton, N. Y. and Boston Univ., Mass.). J. Am. Chem. Soc., 83: 2417-24(June 5, 1961). (BNL-4991)

The kinetics of exchange of p-nitrobenzyl bromide with Br^{82} provided in the form of LiBr, KBr, $(CH_3)_4NBr$ and $(C_2H_5)_4NBr$ was investigated over a wide range of ionophore concentrations at 0° and, with KBr, at –10.2° and +10.75° as well. Neither of the rate expressions, $R_e = k_2(RBr)(MBr)_s$ where (RBr and MBr)$_s$ are stoichiometric concentrations of aralkyl bromide and ionophore, respectively, or $R_e = k_1(RBr)$ correlates the data satisfactorily; k_2 decreases with increasing $(MBr)_s$ while k_1 increases to a much greater degree. The data establish that the variation of k_2 with $(MBr)_s$ is not a salt effect. The rate data were analyzed with the aid of the thermodynamic dissociation constants of the ionophores evaluated from conductance data by Shedlovsky's procedure and of activity coefficients calculated by means of the Debye-Hückel equation and are consistent with the rate law $R_e = k_f(RBr)(Br^-) + k_p(RBr)(M^+Br^-)$ which ascribes different reactivities to free and paired ions. The magnitudes of K_p, but not of K_f, depend to a substantial degree on the values assigned to a_{DH}, the Debye-Hückel "distance of closest approach." Calculations carried out with an IBM 650 computer show that no value of the Debye-Hückel a-parameter in the range from 0 to 30 Å, provides a uniquely superior correlation of the data. The validity of the analysis in terms of k_f and k_p is supported by the fact that k_f is independent of the nature of the cation. In contrast, k_p varies with the nature of the cation in the same sense as does K_d: more tightly bound ion pairs are less reactive. These results support the view that the discrimination between free and paired ions provided by conductivity measurements serves to identify species which differ in their kinetic reactivity but they yield no critical information concerning the precise nature of the paired species. The data are equally consistent with Fuoss' "ions in contact" model or with Bjerrum's original statistical model. The data indicate that SN-1 contribution to the reaction is negligible or, at most, minor. The data are not capable of discriminating

between the analysis in terms of k_f and k_p and a treatment based on catalysis by free cation of displacement by free anion. (auth)

20703 cis-DICHLORODIAMMINEPLATINUM (II). ACID HYDROLYSIS AND ISOTOPIC EXCHANGE OF THE CHLORIDE LIGANDS. John W. Reishus and Don S. Martin, Jr. (Inst. for Atomic Research and Ames Lab., Ames Iowa). J. Am. Chem. Soc., 83: 2457-62(June 5, 1961). (IS-170)

The acid hydrolysis of cis-$[Pt(NH_3)_2Cl_2]$ was studied at 25 and 35°. For the first acid hydrolysis, cis-$[Pt(NH_3)_2Cl]$ + $H_2O \rightarrow$ cis-$[Pt(NH_3)_2Cl(H_2O)]^+ + Cl^-$, the equilibrium constant, K_1, is 3.3×10^{-3} mole/l and the rate constant, k_1, is 2.5×10^{-5} sec^{-1} at 25°. There is no significant direct exchange between the chloride ligands of cis-$[Pt(NH_3)_2Cl_2]$ and Cl^-. For the second acid hydrolysis, cis-$[Pt(NH_3)_2Cl(H_2O)]^+$ + $H_2O \rightarrow$ cis-$[Pt(NH_3)_2(H_2O)_2]^{2+} + Cl^-$, the equilibrium constant K_2 is 4×10^{-5} mole/l at 25°. The exchange of chloride with cis-$[Pt(NH_3)_2Cl(H_2O)]$ occurs at a rate which is chloride-independent and is characterized by a first order rate constant, $k_2 = 3.3 \times 10^{-5}$ sec^{-1} at 25°. It appears likely that this exchange also occurs by only an acid hydrolysis mechanism. (auth)

20704 LOWER OXIDATION STATES OF THE LANTHANIDES. NEODYMIUM(II) CHLORIDE AND IODIDE. Leonard F. Druding and John D. Corbett (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 83: 2462-7(June 5, 1961). (IS-231)

Investigation of the salt-rich portions of the Nd–$NdCl_3$ and Nd–NdI_3 phase diagrams establishes the existence of the incongruently melting $NdCl_{2.3_7}$ (680°), $NdCl_{2.2_7}$ (702°), and $NdCl_{2.00}$ (841°) and the congruently melting $NdI_{1.95}$ (562°). Neodymium(II) chloride is isomorphous with $SmCl_2$ and $NdI_{1.95}$ with $SmBr_2$. The composition and powder patterns of solid solutions of cerium in $NdCl_{2.3}$ suggest substitution of a reduced cerium species, presumably Ce^{2+}, therein. The formation of a face-centered-cubic (Nd, Ce)$Cl_{2.20}$ phase at higher Nd/Ce ratios is considered in terms of anion substitution in the body center of the fluorite structure. A new method is given for the preparation of the pure rare earth metal trichlorides and iodides by the reaction of HCl or I_2 with the metals in molybdenum or tungsten containers, respectively. (auth)

20705 EVIDENCE FOR NITROGEN MIGRATION IN THE BENZILIC ACID REARRANGEMENT OF ALLOXAN AND DERIVATIVES. Harold Kwart, Richard W. Spayd (Univ. of Delaware, Newark), and Clair J. Collins. J. Am. Chem. Soc., 83: 2579-80(June 5, 1961).

The benzilic acid rearrangements of alloxan(I) to alloxanic acid(II) was recently the subject of a kinetic study. Tracer studies with C^{14} show that the nitrogen-carbon shift takes place to the exclusion of the carbon-carbon shift during rearrangement of alloxan and several of its derivatives under widely differing conditions of pH. Data and method of rearrangement are given. (P.C.H.)

20706 THE OSMOTIC APPROACH TO THE PHENOMENON OF ELECTROLYTE INVASION OF ION-EXCHANGE RESINS. Walter A. Platek and Jacob A. Marinsky (Univ. of Buffalo). J. Am. Chem. Soc., 83: 2583-4(June 5, 1961).

The water activity of ion-exchange resins that are invaded by non-exchange electrolyte was measured by an isopiestic technique. Preliminary results were obtained for the systems LiCl–LiR and NaCl–NaR, where R represents Dowex-50 X-8. The resin samples were first equilibrated with external salt solution of various concentrations to obtain a range of mole fractions of electrolyte with the resin phase. After further equilibration by a method not used previously, the osmotic coefficient, ϕ, was obtained as a function of the total molality for several different mole fractions of salt. Results for the system LiCl–LiR are given as a plot of ϕ vs the internal molality, $m = m_{LiCl} + m_{LiR}$. (P.C.H.)

20707 MEASUREMENT OF THE PARTIAL PRESSURE OF CESIUM OVER CESIUM ANTIMONIDES. Kiyoshi Miyake (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Appl. Phys., 32: 1132-6(June 1961).

The partial pressure of cesium over the cesium antimonides at compositions of $Cs_{2.95}Sb$, $Cs_{3.00}Sb$, and $Cs_{3.25}Sb$ was measured at temperatures from room temperature to about 180°C. The experimental tube consists of a spherical glass envelope and an ion gauge. The sample was prepared on the inner surface of the spherical envelope. The partial pressure of the cesium dissociated thermally from cesium antimonides was measured by Langmuir's positive ion method. The composition of the samples was determined by comparing their electrical resistivities and thermal activation energies associated with electrical conductivity with those of cesium antimonides that had a known composition. The preparation of the sample and the measuring method of the partial pressure of cesium were described precisely. The partial pressure was measured as a function of the absolute temperature, and the results showed that it was represented by the equation $\log_{10}p$ (mm Hg) = $A - B/T$, where A and B were constants. In the case of $Cs_{3.00}Sb$, A was 9.040 and B was 6300 deg. (auth)

20708 ON THE REACTIVITY OF URANOURANIC OXIDE. VI. ON THE CHANGES AMONG URANIUM TRIOXIDE AND THEIR HYDRATES. Rokuo Ukazi and Fumikazu Minami (Osaka Metal Ind. Co., Yodogawa Works, [Japan]). J. At. Energy Soc. Japan, 3: 260-5(Apr. 1961). (In Japanese)

Using a thermal balance and an x-ray diffractometer, hydration and dehydration are studied for uranium trioxide UO_3 which is prepared from uranyl nitrate, ammonium diuranate, and uranium peroxide before decomposing to uranouranic oxide. The crystal system of UO_3 I may be monoclinic, UO_3 II also may be of a new crystal system, and UO_3 III is amorphous. These oxides are changed into hydrate by exposing them in air at room temperature for several days or a few months. UO_3 I converts into monoclinic $UO_3 \cdot 2H_2O$ or orthorhombic $UO_3 \cdot H_2O$, and UO_3 II and III both into monoclinic $UO_3 \cdot 2H_2O$. Dehydration of $UO_3 \cdot 2H_2O$ leads through the orthorhombic $UO_3 \cdot H_2O$ to monoclinic UO_3 and then to anhydrous amorphous UO_3. Further, high temperature x-ray study shows that the orthorhombic $UO_3 \cdot H_2O$ begins to decompose at 320°C, converts into amorphous UO_3 at 350°C and then to anhydrous monoclinic UO_3 at 415° to 420°C. (auth)

20709 STATISTICAL MECHANICS OF ISOTOPE EFFECTS ON THE THERMODYNAMIC PROPERTIES OF CONDENSED SYSTEMS. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 34: 1485-93(May 1961). (BNL-4939)

Evidence for the role of molecular structure on the difference in the thermodynamic properties of isotopic molecules in the liquid and solid states is summarized. The properties considered are vapor pressure, heats of vaporization, molal volume, and transition temperatures. It is shown that the molecular structure must be taken into consideration even for small quantum effects. In the approximation of the first quantum correction the difference in thermodynamic properties of isotopic molecules depends

upon the atomic masses and an energy parameter associated with each atom in the molecule. The results are extended to higher-order quantum corrections for a harmonic potential. The rules of the mean are obtained directly. Various frequency distributions for the lattice modes are considered. For the case where the internal frequencies in the condensed phase are similar to the free molecule, ordered quantum corrections can be used in some cases. The role of the gas imperfection and the molal volume of the condensed phase is discussed for equilibria between gaseous and condensed phases. It is shown that the difference in molal volumes of isotopic molecules is a second-order effect. The difference in molal volumes of isotopic molecules is evaluated by an extension of Gruneisen's equation of state to molecular lattices. The results agree with experiment. (auth)

20710 ELECTRICAL CONDUCTANCE OF SOLUTIONS OF SALTS IN LIQUID METALS. POTASSIUM IODIDE IN POTASSIUM. H. R. Bronstein, A. S. Dworkin, and M. A. Bredig (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 34: 1843-4(May 1961).

The electrical conductivity of KI-K solutions at 700°C is measured for 0 to 100% K concentration. The properties of KI-rich and K-rich solutions are discussed. (T.F.H.)

20711 THE REACTION BETWEEN 2,2-DIPHENYL-1-PICRYLHYDRAZYL AND NITROGEN DIOXIDE. J. A. Weil, K. V. Sane, and J. M. Kinkade, Jr. (Argonne National Lab., Ill.). J. Phys. Chem. 65: 710-12(May 1961).

The products of the reaction between nitrogen dioxide and 2,2-diphenyl-1-picrylhydrazyl are identified as being, contrary to previous ideas, mono- and dinitrated diphenylpicrylhydrazines. The hydrazyl free radicals corresponding to these hydrazines are prepared. The high-resolution proton nmr spectra of diphenylpicrylhydrazine and its nitro derivatives, and the paramagnetic resonance spectra of the corresponding hydrazyls, are described. (auth)

20712 SOLUTION PARAMAGNETIC RESONANCE STUDIES OF PARA-SUBSTITUTED HYDRAZYL FREE RADICALS. Mabel M. Chen, Krishna V. Sane, Robert I. Walter, and John A. Weil (Argonne National Lab., Ill. and Haverford Coll., Haverford, Penna.). J. Phys. Chem., 65: 713-17(May 1961).

The electron spin resonance spectra of a series of 2,2-diphenyl-1-picrylhydrazyl free radicals substituted at the para positions of the phenyl rings were observed in dilute solution in benzene. Nuclear hyperfine coupling constants for interaction of the unpaired electron with the hydrazine nitrogen atoms were determined by an automatic curve-fitting procedure. In three cases, these constants were assigned to the individual nitrogen atoms by studying the N^{15} labeled compounds. The observed variations of the coupling constants and line widths were discussed in terms of the known effects of the various substituents on electron delocalization. (auth)

20713 THE THERMAL REACTIONS OF HYDROGEN IODIDE WITH ALKYL IODIDES. John H. Sullivan (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 65: 722-7(May 1961).

The experimental data of Ogg on the rates of reaction of hydrogen iodide with methyl, ethyl, and n-propyl iodides are reinterpreted considering the slow rate determining step to be a reaction between an iodine atom and the alkyl iodide. The experimental data are in agreement with the mechanism: $RI \rightarrow R + I$ (1); $I + RI \rightarrow R + I_2$ (2); $R + I_2 \rightarrow RI + I$ (3); $R + HI \rightarrow RH + I$ (4); $R + RI \rightarrow R'I + RH$ (5); $I_2 \rightleftharpoons 2I$. Independent constants which can be obtained from this system are k_1, k_2, k_3/k_4, and k_5/k_4. The rate of reaction 1 for each of the alkyl iodides is shown to be small compared to the rate of (2). For methyl iodide, $\log k_2$ (mole/cc)$^{-1}$ sec^{-1} = 14.3 − 19,800/4.575T, $k_3/k_4 = 8$, and $k_5/k_4 \neq 0.03$. For ethyl iodide, $\log k_2 = 13.62 - 16{,}700/4.575T$, and $k_3/k_4 = 8$. When the activation energies for (3) are taken to be zero, the C−I bond strengths in CH_3I and C_2H_5I, as determined from the activation energies of (2), are 55 and 52 kcal, in good agreement with values obtained by other techniques. For n-propyl iodide an unequivocal determination of k_2, k_3/k_4, and k_5/k_4 could not be made, but the ratios k_3/k_4 and k_5/k_4 are found to be significantly different from the ratios for methyl and ethyl iodides; the data are fitted by $k_3/k_4 \cong 3 + 5\ k_5/k_4$. (auth)

20714 ON ION-SOLVENT INTERACTIONS. PART I. PARTIAL MOLAL VOLUMES OF IONS IN AQUEOUS SOLUTION. Pasupati Mukerjee (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 740-4(May 1961). (BNL-4331)

The partial molal volumes $\bar{V}_0$ of a large number of ions in aqueous solutions at infinite dilution are examined on the basis of a simple model of ion-solvent interactions according to which $\bar{V}_0$ is the difference between the intrinsic volume of an ion and the electrostriction of the solvent. $\bar{V}_0$ for H^+ is deduced to be −4.5 ml/mole from the experimental data on large monatomic monovalent ions by assuming that the $\bar{V}_0$ does not depend on the sign of the charge. A quantitative semi-empirical analysis of the data suggests that the radii of ions in solution are about 20% larger than in the crystal and that certain aspects of the continuum model apply to large monovalent ions for which the ion-solvent interaction is weak; the electrostrictions are inversely proportional to the radius. The model breaks down for the small Li^+, and polyvalent ions for which the electrostrictions become independent of radius. Ag^+ shows exceptional behavior suggesting that the special interactions of exposed d-electrons must be taken into consideration. Unsymmetrical polyatomic ions such as OH^- and HSO_4^- also show anomalous behavior which can be qualitatively explained by taking their detailed charge distribution into account. (auth)

20715 ON ION-SOLVENT INTERACTIONS. PART II. INTERNAL PRESSURE AND ELECTROSTRICTION OF AQUEOUS SOLUTIONS OF ELECTROLYTES. Pasupati Mukerjee (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 744-6(May 1961).

The electrostrictions in aqueous solutions at infinite dilution of a large number of electrolytes of various complexities and charge types are estimated from results of high pressure compression studies by Gibson. These are compared with the results obtained from the analysis of the partial molal volume data of electrolytes in the preceding paper. The agreement is in general fair and tends to improve qualitatively when the directions of the errors in the estimates from compression studies are examined in detail. The assumptions and conclusions in the analysis of partial molal volumes are thus further substantiated. (auth)

20716 MORE RIGOROUS KINETIC EXPRESSIONS FOR COMPETITIVE PROCESSES IN SOLUTION. Richard M. Noyes (Univ. of Oregon, Eugene). J. Phys. Chem., 65: 763-5(May 1961).

If the reactivity of a molecule depends significantly on the time since its formation, the yields from competitive processes may be influenced in characteristic ways. General equations are set up to describe the competition of unimolecular and bimolecular processes for a reactive

molecule formed singly as in a fluorescence quenching experiment. Approximate solutions developed previously for these equations are satisfactory to within one per cent or better unless the unimolecular rate constant is greater than 10^9 sec^{-1} and/or the viscosity of the medium is more than 0.1 poise. General equations are also developed for the competition of a bimolecular scavenger reaction with the combination processes when reactive radicals are produced in pairs. Approximate solutions developed previously are satisfactory unless scavenger concentrations are of the order of 1 mole/liter. (auth)

20717 THE HEATS OF FORMATION OF SOME UNSTABLE GASEOUS HYDRIDES. Stuart R. Gunn and LeRoy G. Green (Univ. of California, Livermore). J. Phys. Chem., 65: 779-83(May 1961). (UCRL-6116)

The heats of explosive decomposition of PH_3, P_2H_4, SiH_4, Si_2H_6, GeH_4, Ge_2H_6, SnH_4, and B_2H_6, either pure or in mixtures with SbH_3, are measured. Heats of formation and thermochemical bond energies are derived. (auth)

20718 MAGNETIC INVESTIGATIONS OF SPIN-FREE COBALTOUS COMPLEXES. IV. MAGNETIC PROPERTIES AND SPECTRUM OF COBALT(II) ORTHOSILICATE. Margaret Goodgame and F. Albert Cotton (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem., 65: 791-2 (May 1961). (NYO-9115)

The temperature dependence of the magnetic susceptibility and the reflectance spectrum of the purple compound Co_2SiO_4 are reported. Although the color of the compound might suggest the presence of tetrahedrally coördinated Co(II) ions, it is shown that the magnetic data and the details of the spectrum lead unambiguously to the conclusion that the Co(II) ions are octahedrally coördinated. This is in agreement with the previously reported x-ray powder pattern which indicated that Co_2SiO_4 has the olivine rather than the phenacite (Willemite) structure. (auth)

20719 THE MEASUREMENT OF METAL-LIGAND BOND VIBRATIONS IN ACETYLACETONATE COMPLEXES. J. P. Dismukes, L. H. Jones, and John C. Bailar, Jr. (Univ. of Illinois, Urbana and Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 65: 792-5 (May 1961).

The infrared spectra of a large number of metal-acetylacetonate complexes are recorded. The absorption frequencies below 700 cm^{-1} are discussed in terms of coupling of metal-oxygen vibrational modes with three low-frequency vibrational modes of the acetylacetonate anion at 654, 520 and 410 cm^{-1}. It is concluded that no absorption band between 700 to 350 cm^{-1} can be assigned to a pure metal-oxygen vibration. (auth)

20720 THE INTERACTION OF TRI-n-OCTYLAMINE WITH THENOYLTRIFLUOROACETONE AND WITH HYDROCHLORIC ACID. L. Newman and P. Klotz (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 796-800 (May 1961). (BNL-5011)

The reaction between tri-n-octylamine (R_3N) and thenoyltrifluoroacetone (HT) was investigated in benzene by a spectrophotometric approach. The reaction which occurs is observed to be $R_3N + HT = R_3NHT$. The formation constant was evaluated as $(1.4 \pm 0.1) \times 10^3$ and found to be constant over a 1000-fold change in amine concentration. The equilibrium between tri-n-octylamine and hydrochloric acid was investigated by an acid equilibrium method. The postulated reaction, $R_3N_b + H^+_a + Cl^-_a = R_3NHCl_o$ was verified; subscript o indicates substances in a benzene phase and subscript a, in an aqueous phase. The equilibrium constant was measured as $(1.3 \pm 0.3) \times 10^4$. The postulated reaction was tested over an 80-fold change in amine concentration and found inadequate when the amine concentration was greater than 0.02 M. (auth)

20721 RATES OF CHEMISORPTION OF HYDROGEN ON HYDROGEN-COVERED RUTHENIUM SURFACES. Manfred J. D. Low (Texaco Research Center, Beacon, N. Y.). J. Phys. Chem., 65: 887-8(May 1961).

Measurements of hydrogen adsorption rates on ruthenium surfaces containing known amounts of hydrogen were made and are graphically presented. The measurements were made to show the effects of pre-adsorption on chemisorption where the poison and the subsequently adsorbed gas are identical. The equations deduced and the experimental data show that the chemisorption mechanism requires a surface that changes in character during and because of the act of adsorption. (N.W.R.)

20722 PROPERTIES OF FUSED SYSTEMS IN FUNCTIONAL THEORY. Jean-Louis Destouches (Institut Henri Poincaré, Paris). J. phys. radium, 22: 76-82(Feb. 1961). (In French)

Several transformations of the fundamental equations for a fused part of a physical system are given in the functional theory of particles. Objectivity of the values of the m_j coefficients of the particles in the fusion process is shown. Properties of the distinguishable waves in a fused part of a system are derived, and linear phase waves are obtained. The necessary and sufficient conditions for the fusion of two particles are determined, and the properties of the mean wave for a set of fused systems are obtained. The linear equations placed by de Broglie at the base of the fusion theory are deduced. Properties of the mean wave were determined by measurement, and the linear de Broglie equations were obtained (tr-auth)

20723 EMISSION SPECTRUM OF THE RADICALS OH AND OD. L. Herman, P. Felenbok, and R. Herman (Observatoire de Paris-Meudon, France). J. phys. radium, 22: 83-92(Feb. 1961). (In French)

The rotational structure of the (0.6), (0.7), (0.8), and (0.9) OH bands and the (0.8), (0.9), (0.10), (0.11), and (1.11) OD bands of the $B^2\Sigma - A^2\Sigma$ system was measured with a higher dispersion than previously. New values for the rotational constants of the two levels for OH and OD are found. The observed perturbations are attributed to a predissociation of the upper level. This predissociation would be due to dissociation by rotation. This dissociation produces $O(^1S)$ atoms which would be responsible for a short continuum in the OD spectrum and lines in the OH spectrum. Two new bands of the $C^2\Sigma - X^2\Sigma$ system of OH are given. (auth)

20724 VINYL POLYMERIZATION PHOTOSENSITIZED BY URANYL IONS. V. Mahadevan and M. Santappa (Univ. of Madras). J. Polymer Sci., 50: 361-78(Apr. 1961).

A systematic investigation of the kinetics of polymerization of the vinyl monomers methyl methacrylate, methyl acrylate, and acrylonitrile in aqueous solution, photosensitized by uranyl ions, was undertaken. Light of wavelengths 300 to 450 mμ was used for irradiation. Complex formation and ion-pair formation was kept to the minimum. The course of the reactions was followed in terms of rates of monomer disappearance, rates of uranous ion formation, and the chain length of the polymer formed. Under controlled conditions of acidity and ionic strength, quantitative correlations between the various rates and chain length, and the variables (1) fractional light absorption, (2) uranyl ion

concentration, (3) wavelength of incident radiation, (4) monomer concentration, (5) light intensity, and (6) temperature of the reaction were obtained. The influence on the reaction of uranous ion present initially in the system was studied. The quenching of the fluorescence of uranyl ions by vinyl monomers and by other standard quenchers was compared. The tentative mechanism proposed for the overall reaction is discussed. Ratios of specific rate constants and activation energies for the various steps were evaluated. (auth)

20725 ION-MOLECULES REACTIONS OF THE FIFTH GROUP ELEMENT HYDRIDES. A. Giardini-Guidoni and G. G. Volpi (C.N.R.N., Rome). Nuovo cimento, (10), 17: 919-27(Sept. 1960). (CNEN-43). (In English)

Reactions of the type $M^+ + XH = MN^+ + X$, where XH stands for hydrides of the fifth group elements, or deuterium and M^+, were studied. The rate constants, or their upper limits, are determined and compared with theoretical ones. Heats of formation of MH^+ ions are computed. (auth)

20726 THERMOGRAVIMETRIC DECOMPOSITION OF THORIUM 8-HYDROXYQUINOLATE. C. E. Crouthamel and C. E. Johnson (Argonne National Lab., Ill.). Talanta, 8: 377-80(June 1961).

The thermogravimetric behavior of crystalline thorium 8-hydroxyquinolate was correlated with empirical and molecular formulas. The first of two sharp breaks is shown to be due to both water and oxine, and the second to oxine alone. (auth)

20727 CHEMICAL STABILITY OF UO_2 IN REACTOR WATER. C. N. Spalaris (General Electric Co., San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 146-8(June 1961).

20728 SYSTEMATIC TRENDS IN VAPORIZATION AND THERMODYNAMIC PROPERTIES. R. J. Ackermann, R. J. Thorn, and G. H. Winslow (Argonne National Lab., Ill.). p. 12-23 of "Conference on Physical Chemistry in Aerodynamics and Space Flight, held at the University of Pennsylvania, Philadelphia, September 1-3, 1959." New York, Pergamon Press, 1961.

With the theoretical aspects of chemical bonding and the concepts of potential energy functions as guiding principles, the sublimation behavior of refractory oxides is discussed. For all processes in which the significant atomic and electronic configurations are the same in initial and final states, ΔH and ΔE are intimately related so that to trace the trends in thermodynamic properties it is necessary to study the variation with atomic number of only one of these, preferably ΔH. Of the quantities determining the relative volatilities (i.e. relative stabilities of solid and gaseous oxides and metals) the molecular orbital theory successfully describes the trends by rows and groups in the dissociation energies of the gaseous monoxides for only the regular or B subgroups. Without the introduction of an additional factor the theory does not explain the increase in dissociation energies with increasing atomic number as observed in the pretransition group of Ca, Sr, Ba, and Ra, and in the transition groups. This same factor determines the relative stabilities of the solid oxides and metals. The least volatile oxides in the respective A subgroups are Li, Ca, Y, Hf, and perhaps Pa oxides. The variation along and about this "diagonal" line in the periodic table is discussed as a resultant of two components which are manifested by variation from group-to-group and by changes within groups. (auth)

Radiation Chemistry and Radiochemistry

20729 (BRL-MEMO-1336) A STUDY OF THE DOSIMETRIC PROPERTIES OF LOW DENSITY POLYETHYLENE. Joe A. Swisher and Arthur D. Coates (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Mar. 1961. 24p.

Polyethylene samples were exposed to a relatively small (approximately 8.7 curies) cesium-137 gamma source for varying durations of time. The chemical oxidation was measured by infrared absorption techniques, and the physical changes studied by measurements of elongation and tensile strength. All changes were a direct result of the quantity of radiation received. The results indicate that polyethylene has significant potentiality as a wide range gamma dosimetry material. The polymeric dosimeter has proven to be reasonably accurate in the exposure range of 1×10^6 to 5×10^7 roentgens. (auth)

20730 (CISE-85) TECNICHE, APPARECCHIATURE E DATI SPERIMENTALI PER L'ANALISI CHIMICA E RADIOCHIMICA. 5. PARTE I. MISURE DI EMETTITORI BETA CON UN RIVELATORE GEIGER MÜLLER A 4 π. PARTE II. PREPARAZIONE DEI SUPPORTI SOTTILI PER LE SORGENTI. PARTE III. MISURA DELLA QUANTITA DI ORO DEPOSITATA SU STRATI DI VYNS MEDIANTE RADIOATTIVAZIONE. (Techniques, Apparatus and Experimental Data for Chemical and Radiochemical Analysis. 5. Part I. Measurement of Beta Emitters with a 4 π Geiger Müller Detector. Part II. Preparation of the Thin Support for the Source. Part III. Measurement of the Quantity of Gold Deposited on a Layer of VYNS by Means of Radioactivation). F. Gadda (Centro Informazioni Studi Esperienze, Milan). Feb. 1961. 23p.

In the measurement of β emitters with a 4π Geiger-Müller detector the possible causes of error are incorrect geometry, absorption in the source support, and self-absorption in the source material. A study is made of the detector and the possible methods of overcoming the errors. The detector and the filling system are first described, and its operational characteristics are given. The sources of error are then briefly considered as an introduction to the preparation of the source support. The materials studied as source support are zapon, formvar, nylon, nitrate or acetate of cellulose, and vinyl chloroacetate (VYNS). The methods used for the measurement of the surface density of the source support are described, and the metallization of this support is discussed. Samples of VYNS covered with gold were used to determine radiation methods for measuring the quantity of metal deposited on the source support. The techniques used for the sample preparation and irradiation are given, and the results are evaluated. (J.S.R.)

20731 (DP-577) RADIOLYTIC AND CHEMICAL STABILITY OF PURE HYDROCARBONS. Burton P. Dennis (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1961. Contract AT(07-2)-1. 12p.

The tendency of various classes of pure hydrocarbons to form zirconium-complexing ligands during chemical or radiolytic degradation was evaluated. Olefins and aromatic-cycloparaffins (mixed type) formed the most ligands and normal paraffins the fewest. (auth)

20732 (KFK-41) RADIOCHEMISCHE DEMONSTRATIONSVERSUCHE ABTRENNUNG KURZLEBIGER NUKLIDE NACH VERSCHIEDENEN METHODEN. (Radiochemical

Demonstration Experiment Separation of Short-lived Nuclides by Different Methods). W. Seelmann-Eggebert, C. Keller, and G. Zundel, comps. (Kernreaktor Bau-und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany). Jan. 1961. 41p.

Thirteen experiments on the separation of short-lived radioisotopes, which are suitable for demonstration in lectures or as laboratory experiments, are compiled. All the experiments can be carried out in 5 to 20 minutes and give a survey of the various laboratory methods. The experiments given are the separation of Rh^{106} from Ru^{106}, Ba^{137m} from Cs^{137}, Tl^{208} and Tl^{207} from decay products and decay products from each other, and Pa^{234m} from uranium and Th^{234}. (J.S.R.)

20733 (TID-12858) SUMMARY OF PROCEEDINGS OF THE FOURTH CONFERENCE ON THE RADIATION CHEMISTRY OF WATER, MARCH 23–25, 1961. J. W. Falconer, K. C. Kurien, F. W. Mellows, and L. M. Theard, eds. (University of Notre Dame, Notre Dame, Ind.). Contract AT(11-1)38. 68p.

A summary of contributions to the Fourth Conference on the Radiation Chemistry of Water is presented. Radiolysis of water by a pulsed electron beam, work on H_2^+, H_2 yield in the radiolysis of neutral and acid water, radiolysis of aqueous solutions of acetic acid, radiolysis of hydrogen peroxide solutions, radiolysis of aqueous solutions of H_2SO_4, tritium-recoil reactions in aqueous solution, the distribution of the energy losses from the primary particle, formation of HO_2 in deaerated solutions, variation of yields with LET, cupric ion-formic acid system, yields in H_2O and D_2O, and effects of solute concentration are discussed. (M.C.G.)

20734 (UCRL-9603) THE CHEMICAL INTERACTION OF ACCELERATED CARBON-14 IONS WITH BENZENE (thesis). Robert Terrence Mullen (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 14, 1961. Contract W-7405-eng-48. 263p.

Solid benzene at −160°C was irradiated with singly charged C^{14} ions at 5000, 90, and 45 ev. The volatile products of irradiation were analyzed by gas-liquid chromatography in conjunction with internal-flow proportional counting. The yields of three products of the irradiations C^{14}-labeled benzene, toluene, and cycloheptatriene) were found to decrease with decreasing ion energy. At a given ion energy the yields of those compounds were found to increase with decreasing energy density (ev per target molecule). It was found that the toluene-C^{14} produced in this work had the same ring methyl distribution of activities as that formed from C^{14} nuclear recoil labeling in benzene-2-methylpyrazine solution. Some speculative considerations are proposed in regard to the mechanism of formation of these products. In addition to benzene, toluene, and cycloheptatriene, the following C^{14}-labeled compounds were identified as products of the irradiations: allene, propyne, 1, 2-butadiene, 1, 3-butadiene, 1 and (or) isobutene, and 1-butyne. Trace amounts of n-butane and indirect evidence for propane were observed. (auth)

20735 (AEC-tr-4622) EFFECT OF NUCLEAR RADIATION ON GASEOUS REACTIONS. S. Ya. Pshezhetskii. Translated by Helen Basil (Argonne National Lab.) from Khim. Nauka i Promy., 4: 509-15(1959). 15p.

An extensive discussion of the effects of nuclear radiation on gaseous reactions is presented in which both primary and secondary elementary processes are treated. Several reactions are discussed as examples. Some general rules for radioinduced chemical reactions are derived. (D.L.C.)

20736 (CEA-tr-R-1020) PERSPECTIVES DE L'UTILISATION INDUSTRIELLE DU CRACKING THERMIQUE SOUS RADIATIONS D'HYDROCARBURES NORMAUX. (Prospects for Industrial Use of Radiation Thermal Cracking of Normal Hydrocarbons). A. V. Topchiev, L. S. Polak, N. Ya. (Y). Chernyak (Cherniac), V. E. Glushnev, I. V. Vereshchinskii (Vereshchinsky), and P. Ya. (Y). Glazunov. Translated into French from Report CW/11C/84, p.131-8 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 14797.

20737 SELENIUM OXIDATION IN THE RADIATION FLUX OF A NUCLEAR REACTOR, C. Moţoc (Institutul de Fizică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 989-97(1960). (In Rumanian)

The radiation-induced oxidation of amorphous and crystalline selenium in bulky form or in thin films on different substrates was investigated. The oxidation occurred at temperatures where thermal oxidation was negligible. With the aid of a metallographic microscope, needle-shaped SeO_2 microcrystals were observed. The kinetics of selenium oxidation was studied as a function of time. In order to do this, thin films of selenium, obtained by vacuum deposition, were enclosed in quartz phials filled with oxygen and were irradiated during different times. No saturation in the oxidation process was observed at a total neutron flux of 6×10^{11} n/cm^2. The rate of oxidation, inferred from the slope of the straight line, was 2.9×10^{-4} mg/h. From irradiations with γ rays and fast neutrons in Cd sheets, it was concluded that γ rays and fast neutrons contribute to the oxidation process. (auth)

20738 RADIOCHEMICAL SEPARATION OF COBALT. P. C. van Erkelens (Research Inst. for Animal Husbandry, Schoonoord, Utrecht). Anal. Chim. Acta, 24: 526-8(June 1961). (In English)

The method described is based on the extraordinary stability of cobalt diethyldithiocarbamate. Interferences are few; only very small amounts of zinc and iron accompany cobalt, which is important in neutron-activation analysis. (auth)

20739 EFFECT OF RADIATION ON PARAMINOBENZOIC ACID (STUDY ON INDIRECT ACTIONS OF RADIATION). T. Muto. Boei Eisei, 6: 308-13(1959).

An aqueous solution of paraminobenzoic acid (PABA) was irradiated by x rays, and then analyzed. Non-irradiated PABA showed the peak of absorption at 288 μ on the uv absorption spectrum. After irradiation, the absorption peak shifted to the shorter wave side in accordance with the x-ray dose. Qualitative analysis revealed that two peaks seen at 255 and 300 μ after the irradiation of 3×10^6 r were due to paraoxybenzoic acid and paranitrobenzoic acid, respectively. Deamination of PABA was observed after irradiation. The activation energy of NH_3 production was estimated to be under 5000 cal. These results could be explained by the work-hypothesis on the indirect actions of radiation developed by Prof. Wakabayashi. (auth)

20740 PROCEDURES FOR THE ISOLATION OF TANTALUM ISOTOPES PRODUCED BY DEUTERON BOMBARDMENT OF TUNGSTEN. A. Demildt and J. Hoste (Ghent Univ.). Bull. soc. chim. Belges, 70: 145-53(Mar.-Apr. 1961). (In English)

Radiotantalum is produced by deuteron irradiation of tungsten. The radioisotopes of tantalum are separated

from the tungsten by three different chemical procedures, namely by adsorption on iron hydroxide, separation by ion-exchange and liquid-liquid extraction. Identifications of these isotopes are performed and the yields are determined. (auth)

20741 ON THE PHOTOCHEMISTRY OF BIS-[4-METHYL-NAPHTHALIN-(2)]-INDIGOS. [PART] I. Dietrich Schulte-Frohlinde and Freidl Erhardt (Institut für Radiochemie, Karlsruhe, Ger.). Chem. Ber., 93: 2880-4(Dec. 1960). (KFK-44). (In German)

On exposure to light with a wavelength of 590 mμ in a hydroxyl-free solvent, bis[4-methyl-naphthalin-(2)]-indigo rearranges into a 7-keto-5,12-dimethyl-dihydro-dinaphtho (1,2-b:2′, 3′-d) furan. This rearrangement immediately joins a darkness-induced reaction in which 7-hydroxy-5,12-dimethyl-dinaphtho [1,2-b:2′, 3′-d] furan is formed through enolization. Secondary reactions do not enter in dilute solutions. The corresponding 4-chloro- and 4-bromo- derivatives of the bis[naphthalin-(2)]-indigos act the same. (tr-auth)

20742 AN EXAMPLE OF THE ACTIVATION ANALYSIS USED IN THE STUDY OF THE ROLE OF PALLADIUM IN THE FORMATION OF CHEMICAL NICKEL DEPOSITS. J. Aubry (Faculté des Sciences, Nancy [France]), J. Flechon, and S. May. Energie nucleaire, 2: No. 6, 359-67(Nov.-Dec. 1960). (CEA-1889). (In French)

The element or the ion Pd^{2+} is used as a catalyst for the reduction of $Ni(CH_3COO)_2$ by NaH_2PO_2. The palladium is first reduced to crystalline germs on which the nickel can be deposited. By using a radioactive isotope of palladium, it is possible to show that the nickel deposit contains nearly all the palladium and that no palladium reacts in the solution. The study of the purity of the palladium chloride catalyst was carried out by the neutron activation analytical method and the presence of Na^{24} was detected which rendered useless the first measurements. A differential method is described for removing the influence of this ion which interferes with the measurements of the real activities of the radioactive palladium. (EURATOM)

20743 EFFECT OF IRRADIATION CONDITIONS ON THE EXCHANGE REACTION BETWEEN GAS TRITIUM AND ORGANIC COMPOUNDS. Fulvio Cacace and Elvira Possagno (Università, Rome and C. N. R., Rome). Gazz. chim. ital., 90: 1800-6(1960). (In Italian) (CNEN-62)

The effect of tritium pressure and the concentration of noble gases added to the tritium–toluene system was examined. An increase of tritium pressure was found to cause a corresponding increase of the embodiment percentage. A similar effect is obtained by introducing helium in the system up to a pressure of about 80 mm. A further addition of helium produces a decrease in the yield of tritiated hydrocarbon. (auth)

20744 A METHOD OF BULK LIQUID EVAPORATION FOR FALLOUT ANALYSIS. R. Rosen (Dominion X-ray and Radiation Lab., Christchurch, New Zealand). Health Phys., 4: 311(1961).

A method is described for preparing counting samples for the determination of fall-out radioactivity in rain water. The sample is placed on a plastic film in a metal evaporating dish and evaporated to dryness. The plastic sheet is then heated until it melts, ignites, and burns, leaving a sample which can be counted in the same container. (C.H.)

20745 THE RADIATION-INDUCED GRAFT COPOLYMERIZATION OF NATURAL SILK, CAPRON AND VISCOSE. U. A. Arifov (Academy of Sciences, Uzbek. SSR), G. A. Kleyn, A. N. Filippov, N. Yu. Amirova, G. A. Adilkhodzhaeva, G. S. Okun', and L. Kh. Osipova. Izvest. Akad. N. Uzbek. S. S. R., Ser. Fiz. Mat. Nauk, No. 4: 59-64(1960). (In Russian)

By irradiation it is possible to obtain graft polymers of natural silk, capron, and viscose for an immediate contact with the monomers and their solutions. The reaction of the graft copolymerization of the fiber materials with styrene and methylmethacrylate is more extensive than their reaction with vinyl acetate. The synthesis of the graft copolymers takes place easily in the presence of methyl alcohol; often the reaction is accelerated by water. If the graft of styrene and methylmethacrylate takes place under conditions where no strong γ-radiation is necessary, the dynamometric properties of the modified fibers are improved. The copolymerization of the fiber materials with styrene and methylmethacrylate (graft 50 to 80%) takes place in the fiber. (auth)

20746 KINETIC AND ELECTRON SPIN RESONANCE STUDIES OF THE RADIATION DECOMPOSITION CRYSTALLINE CHOLINE CHLORIDE. Robert O. Lindblom, Richard M. Lemmon, and Melvin Calvin (Univ. of California, Berkeley). J. Am. Chem. Soc., 83: 2484-9(June 5, 1961).

The free radicals that accompany the radiation decomposition of crystalline choline chloride were investigated by electron spin resonance spectroscopy. The esr spectrum obtained from the normal compound was compared to the spectra obtained from selectively-deuterated choline chlorides. The differences observed in these spectra were used to assign a structure to the radical. The radical decay reaction was found to be of 3/2 order; this indicates that the observed radicals function as a chain-initiating reactant and not as an intermediate in the radiation decomposition reaction. A kinetic mechanism for this reaction is proposed. The study of the radiation damage was extended to cover a dose range from 0.002 to 200 megarads. An unusual damage-saturation phenomenon was observed at approximately 12% decomposition. (auth)

20747 MECHANISM OF FREE RADICAL DECAY IN IRRADIATED POLYETHYLENE. EVIDENCE FROM DEUTERIUM–HYDROGEN EXCHANGE. Malcolm Dole and Francis Cracco (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 83: 2584-5(June 5, 1961).

Evidence for a new mechanism of free radical migration in solid polyethylene, based on hydrogen isotope exchange between gaseous deuterium and γ-irradiated Marlex-50 polyethylene, is discussed. (P.C.H.)

20748 EVIDENCE OF TRAPPED N ATOMS IN X-RAY IRRADIATED NaN_3. G. J. King, F. F. Carlson, B. S. Miller, and R. C. McMillan (U. S. Army Engineer Research and Development Labs., Fort Belvoir, Va.). J. Chem. Phys., 34: 1499-1500(May 1961).

Sodium azide irradiated with x rays at liquid-nitrogen temperature displays a power-sensitive electron spin resonance spectrum of three equal lines of separation 6.2 gauss. This spectrum is interpreted as N^{14} trapped in the crystal lattice. (auth)

20749 RADIOLYSIS OF CYCLOHEXANE. III. VAPOR PHASE. J. M. Ramaradhya and G. R. Freeman (Univ. of Alberta, Edmonton, Can.). J. Chem. Phys., 34: 1726-9 (May 1961).

The radiolysis of cyclohexane vapor by Po^{210} α particles is investigated. The Po^{210} source is calibrated by ferrous-sulfate dosimetry, using $G(Fe^{+++}) = 5.5$. The product yields are studied as a function of dose. The initial yield for hydrogen is $G(H_2)_i = 8.0$. The fraction volatile at −112°C,

consisting of C_2, C_3, and C_4 hydrocarbons has an initial G value of 4.9 ± 0.5. The poor agreement in material balance is tentatively ascribed to ion-molecule reactions, since ions formed during radiolysis have a life time of the order of 10^{-3} sec. The value of the ratio G(cyclohexene)/(dicyclohexyl) = 1.67 is similar to that found in liquid cyclohexane radiolysis. The G values for various types of cyclohexane fragmentation are also given. (auth)

20750 IRRADIATION YIELDS OF RADICALS IN GAMMA-IRRADIATED ICE AT 4.2° AND 77°K. Seymour Siegel, John M. Flournoy, and Lillian H. Baum (Aerojet-General Corp., Azusa, Calif.). J. Chem. Phys., 34: 1782-8(May 1961).

The electron paramagnetic resonance (EPR) spectra of both ice and deuterated ice that are subjected to γ irradiation at 4.2°K are presented and discussed. Experimental radical irradiation yields at 4.2°K are reported for the H_2O system as a function of sustained irradiation dosage. A comparison between the irradiation yields at 4.2 and 77°K is given and the resulting similarities discussed in terms of intra-spur reactions. Evidence is presented for the existence of an appreciable isotope effect for the irradiation yields in a mixture of H_2O and D_2O. (auth)

20751 THE PART PLAYED BY C_3O_2 IN THE RADIOLYSIS OF CO_2. J. Sutton, M. Faraggi, and M. Schmidt (Commissariat a l'Energie Atomique, [Paris]). J. chim. phys., 57: 643-6(1960). (CEA-1818). (In French)

The products obtained when CO_2 is subjected to the action of slow electrons in an ozonizer are CO, O_2, and O_3. The effect of adding small concentrations of C_3O_2 to the CO_2 current before and after its passage through the discharge is investigated. The results may be explained in terms of two fast reactions: $C_3O_2 + O \rightarrow C_2O + CO_2$; $C_2O + O \rightarrow 2\ CO$, and two slow reactions: $C_3O_2 + O_2 \rightarrow CO_2 + O_2 + C_2O$; $C_2O + O_3 \rightarrow 2\ CO + O_2$. The part played by these reactions in the mechanisms of CO_2 radiolysis and CO photolysis is discussed. (EURATOM)

20752 RADIOCHEMICAL SENSITIZATION BY SEMICONDUCTORS. Jacques Preve and Roger Montarnal (Centre d'Études Nucléaires, Grenoble, France). J. chim. phys., 58: 402-8(Apr. 1961). (In French)

It is possible to sensitize the radiochemical formation of phenol by semiconductors. This sensitization must take place by a mechanism analogous to that for the formation of H_2O_2. The energy absorbed by the sensitizer was determined, permitting the calculation of G for the semiconductor. (tr-auth)

20753 RADIOLYSIS OF DILUTE SOLUTIONS OF DIPHENYLPICRYLHYDRAZYLE (DPPH) IN ORGANIC SOLVENTS. IV. NATURE OF THE ADDITION PRODUCTS. INTERCEPTION CHEMICAL PROCESSES. Lucien Bouby, Adolphe Chapiro, and Éphime Chapiro (C.N.R.S., Bellevue, France). J. chim. phys., 58: 442-54(Apr. 1961). (In French)

The nature of the addition compounds formed during the irradiation of chloroform and carbon tetrachloride in the presence of DPPH and during the reaction of DPPH with chlorine, hydrochloric acid, and phosgene was studied by chromatography on alumina. The principal fraction, isolated among the products of these different reactions, is constituted by red-orange compound whose spectrum is identical with that of the diphenylpicrylhydrazine DPPH-H. The chromatograms contain "black bodies" which possess intense absorption bands at long wave lengths and which are paramagnetic. These "black bodies" which are probably substitute derivatives of DPPH yield by reduction red-orange substances having the same spectrum as hydrozine DPPH-H. However on reoxidation, these hydrozines give the "black bodies"; they act then as substituted hydrazines. The "black bodies" can be reduced to two types of compounds: blue-black compounds formed during the irradiation of chloroform or from the action of DPPH on phosgene and brown-black compounds resulting from the radiolysis of CCl_4 or from the action of DPPH on chlorine. The elementary analysis of this last compound indicates that it contains more than 3 Cl/molecule. It was concluded that the chemical mechanisms of the interception of free radicals by DPPH is in reality more complex than a simple reaction of radical combination. However, the secondary reactions do not appear to perturb in a significant manner the radical yields determined by the DPPH method. (tr-auth)

20754 PEROXYDATION OF Ti^{IV} IN SULFURIC SOLUTIONS IRRADIATED BY γ RAYS OF Co^{60}. Odette Bagno and Jacques Pucheault (Institut du Radium, Paris). J. chim. phys., 58: 465-6(Apr. 1961). (In French)

The initial yield for the formation of the pertitanic compound in 0.8 N H_2SO_4 solutions of Ti^{4+} irradiated by Co^{60} γ rays is equal to 1.30 ± 0.10 mol/100 ev. For the same Ti^{4+} concentration, this formation leads the same stationary state as decomposition. (tr-auth)

20755 EFFECTS OF TEMPERATURE AND ADDED HEXACHLOROETHANE ON THE RADIOLYSES OF CARBON TETRACHLORIDE AND CHLOROFORM. F. J. Johnston, Tung-Ho Chen, and K. Y. Wong (Univ. of Louisville, Ky.). J. Phys. Chem., 65: 728-30(May 1961).

HCl yields from irradiated chloroform are, for doses at least as high as 1.3×10^{21} ev per gram, greater at 70 ± 4° than at 20°. The initial G-value at the higher temperature is 31 compared with an average of 11.9 at 20°. Chlorine yields from irradiated carbon tetrachloride are slightly smaller at 70 ± 4° than at 20°. The corresponding G-values are 0.58 and 0.65. The addition of hexachloroethane to carbon tetrachloride prior to irradiation causes a nearly linear decrease in $G_{(Cl_2)}$ with per cent hexachloroethane. The addition of hexachloroethane to chloroform prior to irradiation causes, at low doses, an increase in $G_{(HCl)}$ above that in pure chloroform. $G_{(HCl)}$ in chloroform–hexachloroethane mixtures decreases with dose and above approximately 1×10^{21} ev per gram, becomes less than in pure chloroform. These results are discussed in terms of free radical mechanisms. (auth)

20756 HYDROGEN YIELDS IN THE RADIOLYSIS OF AQUEOUS HYDROGEN PEROXIDE. A. R. Anderson and Edwin J. Hart (Argonne National Lab., Ill.). J. Phys. Chem., 65: 804-10(May 1961).

Hydrogen and oxygen yields are determined for the γ and deuteron radiolysis of aqueous hydrogen peroxide over a concentration range from pure water to 96% hydrogen peroxide by volume. The observed decrease in hydrogen yields with increasing concentration of hydrogen peroxide is in good agreement with the Flanders-Fricke computations on the one radical diffusion model for both γ and deuteron radiolysis. In order to fit the experimental data to the theoretical curve a rate constant for the scavenging reaction, $H + H_2O_2$, is used in neutral solution about five times the value in acid solution (0.8 N H_2SO_4). This difference in rate constants is consistent with the existence of two reducing species in the radiolysis of water. The observed yields of oxygen are proportional to $[H_2O_2]^{1/4}$ up to hydrogen peroxide concentrations of about 3 M for the deuteron radiolysis of neutral solutions and for the γ radioly-

sis of both acid and neutral solutions; in acid solution, however, the oxygen yields are considerably lower. This increased stability in acid solution probably is associated with a change in the propagation step in the chain decomposition of hydrogen peroxide. (auth)

20757 ELECTRON PARAMAGNETIC RESONANCE STUDY OF IRRADIATED POLYVINYL CHLORIDE. E. J. Lawton and J. S. Balwit (General Electric Co., Schenectady, N. Y.). J. Phys. Chem., 65: 815-22(May 1961).

Polyvinyl chloride irradiated at −196° with 800 kv (peak) electrons was examined for paramagnetic resonance to determine the types of radicals formed at −196° and the behavior of the radical responsible for subsequent chain dehydrochlorination and color formation. Several different radicals are formed at −196° giving rise to a composite spectrum having an over-all spread of 170 gauss between outermost peaks of the derivative spectrum. At room temperature radicals formed at −196° decay at different exponential rates thought to represent the different radical components, and the over-all spectrum narrows rapidly. The primary radical (1) $-CH_2-\dot{C}H-CH_2-$, decays during the first 2 minutes and after 5 minutes 83% of all radicals have decayed. Polymer radical-pair formation during radiolysis followed by crosslinking on warming is postulated to explain the fast decay. The slowest decaying radical gives a single line spectrum 26 gauss wide and accounts for only 7% of all formed and decayed only 10% during 1800 hours at room temperature in nitrogen. It is believed that this spectrum is given by the unstable propagating radical $-CH=CH-CH=\overleftarrow{C}H-\dot{C}H-\overrightarrow{C}H-CH(Cl)-CH_2-$, which sustains chain dehydrochlorination leading to HCl, conjugated unsaturation, and color. Hydrogen is produced during the radiolysis indicating that polymer radicals of the type $-CH_2-\dot{C}(Cl)-CH_2-$ and $-CH(Cl)-\dot{C}H-CH(Cl)-$ are formed. The radiation yield for hydrogen at −196° is $G(H_2) = 0.4$. The yield for total radicals is G = 2.1, and for primary radical (1) and HCl is G = 0.5. The yield for the fraction of unstable radicals causing dehydrochlorination is G = 0.14. The yield for potential crosslinks is G = 0.97. Changes in color and e.p.r. spectrum on annealing were followed to 400°. Narrowing of the spectrum with increasing temperatures is attributed to further delocalization of the odd electrons along the conjugated sequence of double bonds. (auth)

20758 VAPOR PHASE γ-RADIOLYSIS OF AZOMETHANE. Louis J. Stief and P. Ausloos (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 65: 877-81(May 1961).

The effect of scavengers, pressure, temperature, and added xenon on the vapor phase γ-radiolysis of azomethane is investigated. Most of the results can be explained on the basis of free radical reactions similar to those occurring in the photolysis of azomethane. Values for the ratio of rate constants $k_1/k_2^{1/2}$ for the reactions $CH_3 + CH_3N_2CH_3 \rightarrow CH_4 + CH_2N_2CH_3$ (1) and $CH_3 + CH_3 \rightarrow C_2H_6$ (2) determined from the radiolysis data are in excellent agreement with values based on photolysis experiments, indicating that methane and ethane are formed by the reactions of thermalized methyl radicals. The results are best explained on the basis of the decomposition of an electronically excited molecule, formed either by direct excitation or by ionization followed by neutralization. Ion decomposition and ion-molecule reactions of the usual type are shown to be inconsistent with the results. (auth)

20759 MATHEMATICAL CONSIDERATIONS ON CHEMICAL KINETICS OF RADIATION-INDUCED POLYMERIZATION. Ayao Amemiya and Mitio Inokuti (Tokyo Univ.). J. Phys. Soc. Japan, 16: 949-60(May 1961).

The chemical kinetics of radiation-induced polymerization is mathematically investigated. The implication of the "stationary state" hypothesis, currently employed in kinetic treatments, is carefully examined. It is shown that the hypothesis is valid only in a certain time interval. Qualitative behaviors of the total number of polymer radicals as well as of polymer molecules as a function of time are derived without resorting to the stationary state hypothesis. In particular, the asymptotic behavior of the total number of radicals proves to be sensitive to the mode of termination reaction. It is also confirmed that the molecular size distribution approaches to the Poisson type asymptotically. (auth)

20760 THE USE OF HIGH-ENERGY IRRADIATION IN AN INVESTIGATION OF THE MECHANISM AND KINETICS OF EMULSION POLYMERIZATION. J. W. Vanderhoff, E. B. Bradford, H. L. Tarkowski, and B. W. Wilkinson (Dow Chemical Co., Midland, Mich.). J. Polymer Sci., 50: 265-86(Apr. 1961).

The emulsion polymerization of styrene initiated by γ rays was studied using competitive particle growth and conventional techniques. With γ rays, the rate of free-radical generation is independent of temperature, and the absorption of energy is uniform throughout the system. From the competitive growth experiments, the particle growth rates were similar to those of persulfate ion-initiated systems and different from those of benzoyl peroxide-initiated systems. From the conventional experiments, the number of particles increased approximately as the square of the emulsifier concentration for both γ and persulfate ion-initiated polymerizations. With γ rays, the number of particles decreased with increasing temperature; the opposite was observed for persulfate. This may be explained by the relative rates of free-radical generation of each system; for γ rays this rate is independent of temperature, while for persulfate, the activation energy for initiator decomposition is greater than that for polymerization propagation. For the γ ray system, the calculated values of k_p increased with increasing particle size; the activation energy was 7.2 ($\sigma = 0.59$) kcal/mole. The calculated values of k_t at 50°C were 10^4 to 10^5 l/mole/sec. (auth)

20761 ELECTRON SPIN RESONANCE STUDIES OF THE RADICALS PRODUCED IN HIGH POLYMERS BY γ-IRRADIATION AND THEIR REACTION WITH SULFUR DIOXIDE. Zenichiro Kuri and Hisashi Ueda (Tokyo Labs. of Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Polymer Sci., 50: 349-59(Apr. 1961).

Reactivities of free radicals formed in irradiated polymers were investigated. Procedures utilizing the electron spin resonance technique showed the behavior of free radicals with SO_2. Radicals from polymers containing an intramolecular with hydrogen bonds, such as cellulose, starch, and polyvinyl alcohol, etc., showed no reactivity following either irradiation in a SO_2 atmosphere or in vacuo with subsequent introduction of SO_2. Other polymer radicals were classified into three groups according to the effects of SO_2. (auth)

20762 THE VULCANIZATION OF POLYDIMETHYLSILOXANE RUBBER USING γ-RADIATION. I. Ya. Poddubnye, V. N. Kartsev, S. B. Aver'yanov, Yu. V. Trenke, L. A. Aver'yanova, and V. F. Yevdokimov (All-Union Scientific Research Inst. of Synthetic Rubber im. S.V. Lebedev, [USSR]). Kauchuk i Rezina, No. 9, 5-15(1960). (In Russian)

The vulcanization of polydimethylsiloxanes is accomplished by a free-radical mechanism. Results are cited from experimental work conducted to increase the temperature-stability of polymethylsiloxane vulcanizates and to improve their physico-mechanical properties by radiation vulcanization combined with a change in the preparation of the rubber mixture and by introducing new components into the rubber composition. Co^{60} with an activity of 1450 g -eq of radium was used as the source. The dose was 0.28 to 0.72 Mr/hr. The characteristic feature of radiation vulcanization appears to be the energy absorbed by the filler, the possibility of further redistribution of the energy by the polymer and the filler, and the formation of a chemical bond between them. Rubbers with satisfactory tensile and elastic properties may be obtained by radiation vulcanization in combination with the introduction of various additives containing powdered silica gel after a lengthy period of thermal aging at 300°C. Further refining of the rubber mixture increases the thermal resistance. Radiation vulcanizates of polymethylsiloxane rubber filled with carbon black may be produced with relatively high physico-mechanical properties and an elevated thermal resistance. The vulcanizates were current-conducting. Radiation vulcanizates of polymethylsiloxane rubber filled with powdered silica gel and carbon blacks are superior to peroxide vulcanizates in their temperature stability. At a temperature of 200°C radiation vulcanizates were obtained with high physico-mechanical properties. The tensile properties of radiation vulcanizates filled with powdered silica gel may be considerably increased by introducing iron oxides or zirconium oxides into the rubber mixture, as well as by preliminary refining. They surpass the corresponding peroxide vulcanizates in their thermal resistance in closed systems at an elevated pressure and are characterized by their higher values of elasticity restoration after various periods of thermal aging, by their lower values of residual compression deformation at 150 to 200°C, by a lower weight loss during thermal aging and a somewhat higher frost-resistance. They do not differ from the peroxide vulcanizates in dielectric properties, hardness, elasticity, and tear-resistance. (auth)

20763 RADIOLYSIS OF CARBON TETRACHLORIDE IN THE PRESENCE OF OXYGEN. Zd. Spurný (Nuclear Research Inst., Prague) and I. Janovský. Nature, 190: 624-5 (May 13, 1961).

Carbon tetrachloride was exposed to gamma radiation from a Co^{60} source in the presence of oxygen. Data are presented on the formation of chlorine and phosgene. (C.H.)

20764 THE IMPORTANCE OF HYDROXYL RADICALS AS INTERMEDIATES IN THE CROSS-LINKING OF HIGH POLYMERS BY γ-IRRADIATION. Yoshitada Tomoda and Minoru Tsuda (Government Chemical Industrial Research Inst., Tokyo). Nature, 190: 905(June 3, 1961).

Experimental results indicate that cross-linking of gelatin induced by radiation is dependent on generation of free radicals by the action of the gamma rays on water, and that these radicals attack gelatin in reactions which probably involve abstraction of hydrogen atoms, thereby forming free radicals on the gelatin chains which become the cross-linking sites. Any organic liquid present diminishes the cross-linking either by competing with the gelatin for radicals from the water or by interfering with the cross-linking process. The experiments were performed on gelatin films (thickness 0.5 to 1.0 mm) with cobalt-60 gamma rays at a dose-rate of 4.2×10^4 r hr^{-1} at 10°C. (N.W.R.)

20765 STUDY ON INDIRECT ACTIONS OF RADIATION. EFFECTS OF GAMMA-RAYS ON AQUEOUS SOLUTION OF PARA-AMINO BENZOIC ACID (PABA). Y. Nakayama (Hokkaido Univ., Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 19: No. 5, (1959).

A weak aqueous solution of PABA was irradiated by x and γ rays, and the decomposition was analyzed by a modified Bratton-Marshal method. The effects of both rays on PABA were quite similar. The effects were dependent only on the total radiation doses given, regardless of time-dose correlation. The effects were not influenced by temperature during the irradiation. Even when the PABA solution was cooled before x irradiation, the effect was approximately the same as at room temperature. Alcohol, acetone, ether, and glucose added to the PABA solution diminished more or less the radiation effect indicating that these substances had protective effects against the decomposition of PABA caused by irradiation. These protective effects were in proportion to their molecular size. (auth)

20766 THE ANION-EXCHANGE SEPARATION OF TECHNETIUM, RHENIUM AND MANGANESE. Miroslav Pirs and Robert J. Magee (Queen's Univ. of Belfast). Talanta, 8: 395-9(June 1961).

An anion-exchange method for the separation of Tc, Re, and Mn is outlined. After sorption on the resin column, Mn is first eluted with HCl, Re with ammonium thiocyanate in HCl, and Tc with HNO_3. In the eluates Re is determined colorimetrically and Tc radiochemically. As little as 10 μg of Tc in the form of potassium pertechnetate can be separated from 15 mg of Mn as potassium permanganate and 0.8 mg of Re in the form of potassium perrhenate. (auth)

20767 CORRELATION OF THE RADIATION CHEMISTRY OF LIQUID HYDROCARBONS WITH THE ENERGETICS OF MOLECULAR-ION REACTIONS. T. Ffrancon Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 57: 755-63(May 1961).

Exothermic reactions involving alkane parent ions are considered to precede the neutralization process in the liquid state. Thermochemical calculations show that carbon-carbon scission is energetically preferred for branched alkane ions whereas the corresponding dissociation of linear hydrocarbon ions is less favored. Hydrogen-atom detachment from a parent ion is not a facile process but the removal of molecular hydrogen to produce an olefin ion is exothermic in trans-vinylene group formation. A reaction of the parent ion with a molecule is often exothermic and can lead to dimer formation. These considerations afford a rational basis for the interpretation of the radiation chemistry of hydrocarbons as a function of molecular structure; an explanation is derived for the occurrence of either cross-linking or degradation in irradiated vinyl polymers. (auth)

20768 RADIOCHEMICAL OXIDATION OF HYDROCARBONS. Stanisław Ciborowski (Inst. of General Chemistry, Warsaw). Wiadomosci Chemi., 15: 225-46(Apr. 1961). (In Polish)

A review of literature concerning the influence of ionizing radiation on the oxidation of hydrocarbons is given. The mechanism of these reactions is discussed. (auth)

20769 THE CHEMISTRY OF NUCLEAR PROCESSES. II. APPLICATION OF URANIUM FISSION TO THE SYNTHESIS OF CARRIER-FREE RUTHENOCENE (Ru^{103}). F. Baumgärtner and P. Reichold (Technische Hochschule, Munich). Z. Naturforsch., 16a: 374-9(Apr. 1961). (In German)

The possibility of recoil labelling with high energy fission fragments was investigated. It was found that in a mixture of ferrocene with a uranium compound the fission of uranium produces ruthenocene and iodine ferrocene. By this method carrier-free $Ru^{103}(C_5H_5)_2$ was produced. The relative yield of ruthenocen- (Ru^{103}) was measured with different ratios of uranium to ferrocene, ranging from 0.013 to 0.325. At a ratio of 0.013 about 60% of the total Ru^{103} is bound in form of ruthenocene. The yield decreases to 45% at a ratio of 0.325. In order to explain these high yields, it is suggested that the labelling is performed not only by the primary fission ruthenium-103, but especially by secondary ruthenium-103 formed by β decay. (auth)

20770 THE ADSORPTION OF Po(IV) AND SOME OTHER METALLIC IONS ON CELLULOSE FROM SOLUTIONS EITHER OF HCl OR THEIR SALTS. T. J. Beckmann and M. Lederer (Institut du Radium, Arcueil, France). p.279-304 of "VII Rassegna Internazionale Elettronica e Nucleare. V Congresso Nucleare 1960. Volume Secondo." Rome, Comitato Nazionale Richerche Nucleari, [1960]. (In Italian)

Processes for the adsorption of inorganic substances on cellulose are described. These include precipitation, ion exchange, complex formation, adsorption analogous to solvent extraction, and separations and adsorptions in some concentrated electrolytes. Experimental results are given on the adsorption of halogen complexes from solutions either of HCl or HBr or of their salts. Chromatograms were made by the ascending method in glass bottles at room temperature on Whatman No. 1 filter paper. The Rf values of Cr^{6+}, Mo^{6+}, Sb^{5+}, Re^{7+}, Au^{3+}, Po^{4+}, and Ga^{3+} were studied at different concentrations of HCl, HBr, LiCl, NaCl, KCl, and $CaCl_2$. The variations of the ratio solvent/paper are determined as a function of increasing concentrations of HCl, LiCl, and HBr. The curve of the variation of these coefficient as a function of the normality of the eluant appears to have in each case a break which is a characteristic of the eluant and not of the substance. The effect of temperature was also studied. (J.S.R.)

20771 EFFECT OF RADIATION ON ORGANIC COMPOUNDS. Milton Burton and Joseph Y. Chang (Univ. of Notre Dame, Notre Dame, Ind.). p.31-7 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Reaction mechanisms involved in the radiation chemistry of aqueous solutions of organic compounds are reviewed. Typical primary and secondary reactions are tabulated and discussed. (C.H.)

20772 MODIFIED LINEAR POLYETHYLENE. Kenneth Stevens (to Distillers Co. Ltd.). British Patent 863,395. Mar. 22, 1961.

A process for producing material from linear polyethylene having improved stress-cracking resistance is described. The process consists of irradiating linear polyethylene with high-energy radiation while the linear polyethylene is in contact with vinyl chloride. The average molecular weight is greater than 30000. (N.W.R.)

20773 IMPROVEMENTS RELATING TO FLUORINATED POLYMERS. Solomon Harris Pinner (to T. I. Group Services, Ltd.). British Patent 864,893. Apr. 12, 1961.

A process for making a sheet of polytetrafluoroethylene receptive to adhesives while retaining its mechanical properties is described. It consists of exposing a surface of the polytetrafluoroethylene to the action of ionizing radiation while in contact with a liquid monomer characterized by the structure $R_1R_2CCH_2$ in which R_1 is an organic radical and R_2 is a hydrogen atom or an organic radical. Only one surface of the sheet is exposed to the radiation, and the energy is insufficient to penetrate the opposite side. The energy is reduced before striking the surface by passing the electrons through a metal or inert material. For high energy electrons the dose is not greater than 10 megarads or 500,000 rads for gamma rays. The beta-ray emitter is used for producing the ionization radiation. The liquid monomer is either vinyl acetate or styrene. (N.W.R.)

20774 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PRODUCTION OF COPOLYMERS. (to Houilleres du Bassin du Nord et du Pas de Calais). Britis Patent 866,131. Apr. 26, 1961.

A process for the grafting of random copolymers is described. The process consists of activating polyethylene with ionizing radiation and reacting the irradiated polymer simultaneously with at least two monomers, either styrene and acrylonitrile or ethylene and vinylidene chloride, whic are capable of copolymerizing randomly with one another and which would form a copolymer of different constitution from the polyethylene. (N.W.R.)

20775 IMPROVEMENTS IN AND RELATING TO THE PRODUCTION OF COMBUSTIBLE GASES FROM HYDROCARBONS. Jack Swaine, Caradoc Hughes, and Felix Ferdinand Rixon (to Power-Gas Corp., Ltd.). British Patent 866,161. Apr. 26, 1961.

An apparatus is designed and a process is described for the production of combustible gases from gaseous or liquid hydrocarbons. The process consists of continuously passing a mixture of gaseous or vaporized hydrocarbons and oxidizing endothermic gasifying medium through a reaction zone in a heated reactor in which the reactants are maintained at a temperature below 700°C, preferably 350 to 550°C, and which contains radioactive material emitting gamma rays or beta particles or both but not undergoing fission and from which reactor the combustible product is continuously withdrawn. The radioactive material is cobalt-60, cesium-134, cesium-137, europium-154, europium-155, nickel-63, technetium-99, promethium-147, thallium-204, ruthenium-106, strontium-90 or a compound of any of these materials. The apparatus or reactor consists of a heated furnace chamber through which passes a tube having an inlet at one end for gaseous or vaporized hydrocarbons and oxidizing medium and an outlet at the other end for combustible product gas. The tube contains radioactive material emitting gamma rays or beta particles or both but not undergoing fission. The radioactive material is supported on a grid in a sealed container. (N.W.R.)

20776 METHOD OF RECOVERING GELATIN. (to General Foods Corp.). British Patent 866,622. Apr. 26, 1961.

A method for recovering gelatin from a gelatin charge stock by irradiation with cobalt-60 gamma radiation is described. The gelatin extracted from the dry stock has improved physical properties. The extraction is carried out using 0.02M hydrochloric acid at 65°C with the dose of penetrating radiation being between 0.5 to 1.5×10^6 rep. The gamma radiation has an energy of 10^{-3} to 15 Mev. (N.W.R.)

20777 PHOTOPOLYMERIZATION OF VINYL MONOMERS BY MEANS OF SILVER COMPOUNDS AS CATALYSTS PROMOTED BY OXIDES. (to General Aniline & Film Corp.). British Patent 867,980. May 10, 1961.

The formation of solid polymers by photopolymerization of normally liquid or solid monomeric vinyl compounds by

employing a radiation-sensitive silver compound as the catalyst and a suitable oxide as a promoter for the catalyst is described. It consists of irradiating such a monomer in the presence of water with radiation of a wave length ranging from 10^{-1} to 10^{-10} centimeters, using a catalytic amount of radiation-sensitive silver compound as a catalyst and promoting the catalytic activity of the silver compound with zinc oxide, zirconium dioxide, titanium dioxide, or silicon dioxide, but excluding the use of a silver compound which is a very active oxidation agent. (N.W.R.)

20778 NEW GRAFT COPOLYMERS. Robert Roy Smith (to B. X. Plastics, Ltd.). British Patent 870,052. June 7, 1961.

A process for the manufacture of graft copolymers of cellulose triacetate and styrene or a methyl substitution product of styrene in which the methyl group is in the nucleus, e.g. vinyl toluene, is described. The cellulose triacetate is subject to ionizing radiation, accelerated electrons, while in contact with styrene monomer. The cellulose triacetate constitutes more than 5% by weight of the original mixture of cellulose triacetate and styrene monomer. The irradiation is carried out in the absence of oxygen. (N.W.R.)

20779 AUTOMATIC DEVICE FOR TAKING SAMPLES OF ACTIVE SOLUTIONS. André Redon (to Commissariat à l'Energie Atomique). Canadian Patent 618,764. Apr. 18, 1961.

An automatic device for taking samples of active solutions, which makes it possible to reduce the number of actions and affords efficient protection against radiation and contamination, is described. The sampler consists of a sample bottle, a conduit feeding the bottle, means controllable by a single action to place the solution under vacuum, and an electro-pneumatic motor system consisting of a liquid switch which makes use of the contact between the active solution and the feeding conduit. The vacuum means causes the solution to come in contact with the feeding conduit and to start to penetrate the feeding conduit. The system further consists of a vacuum valve and an atmospheric valve, the contact closing the vacuum valve opens the atmospheric valve which causes separation of the body of the solution from the fraction of the solution which has penetrated the feeding conduit. Operations of the two valves are determined by the separation that takes place at a given moment to collect the desired quantity of active solution. The sampler also contains a lead shield, carriage system for moving the equipment, and a safety or security system which works automatically or by manual control. The electro-pneumatic motor system returns to its initial state after each sample is taken to permit taking several successive samples. (N.W.R.)

Raw Materials and Feed Materials

20780 (MCW-1464) PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1961. (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). May 1, 1961. Contract W-14-108-eng-8. 63p.

Analytical tests were made for the presence of surfactants in uranium ore concentrates based on the reduction of the interfacial tension between TBP-hexane and very dilute nitric acid in the re-extraction cycle. The start-up of the continuous, full-flow solvent-treatment system led to excessive consumption of alkaline reagents, caused by traces of carbon dioxide dissolved in the TBP-hexane solvent. Work on the electrolytic preparation of uranium from uranium dioxide has continued. Several possible electrolyte compositions were evaluated, and methods for reducing anode "basket" erosion were developed. Production of 98% UF_4 was demonstrated in the two-stage pilot-plant fluid-bed hydrofluorinator with 1.05-times-theory anhydrous HF and simulated azeotrope recycle. Dissolution of uranium tetrafluoride in an acidic fusion is utilized in the preparation of samples for the determination of nickel, molybdenum, and vanadium. The reduction reactivity of pot-denitrated UO_3 containing 700-ppm sulfate increases as particle size is decreased. Grinding the larger UO_3 particles increases the reduction reactivity. Optimum hydrofluorination rates are achieved at about 3700 pm sulfate. The increased reactivtiy caused by sulfation is a result of increased UO_2 surface area. Ammonium oxalate insolubles, water soluble, and metallic impurities are not uniformly distributed in green salt. Particle size-distribution curves in the sub-sieve range can be obtained by following the changing density of a slurry as the solids settle and applying Stokes' law to the resultant data. The method was successfully performed using an automatic recording balance and a glass plummet to follow density changes. The cost of preparation of uranium metal samples for gas analysis was materially reduced by use of an acid cleaning bath under ultrasonic agitation, rather than the filing technique previously used. (auth)

20781 METHOD OF PRODUCING URANIUM METAL. Alberto Cacciari, Ruggero de Leone, Carlo Fizzotti, and Mario Gabaglio (to C. I. S. E.). Canadian Patent 614,071. Feb. 7, 1961.

A process for the production of metallic uranium or uranium alloys through thermic reduction of a uranium double fluoride with an excess of reducing agent selected from a group consisting of alkali metals, alkaline earth metals, and aluminum is described. The process consists of heat treating the uranium double fluoride to raise its apparent density, grinding the densified fluoride, mixing the ground product with the reducing agent, tamping the resulting mixture, and bringing about the reduction by heating the mixture. The uranium double fluorides are heat treated between 110°C and the melting point of the fluorides. (N.W.R.)

20782 DRY PROCESS FOR THE PRODUCTION OF FLUORINE COMPOUNDS OF URANIUM OF THE TYPE $(UF_4)_zR_xF_y$. Albert Level and Bernard Cochet-Muchy (to Commissariat a l'Energie Atomique). Canadian Patent 616,525. Mar. 14, 1961.

A dry process for the preparation of fluoride derivatives of uranium of the type $(UF_4)_zR_xF_y$, R representing a metal selected from the group consisting of alkaline metals, rare earth alkaline metals, and lead, is described. The preparation consists of subjecting a uranate of one of the metals to the action of a reducing agent and of hydrofluoric acid. The reaction conditions are chosen to obtain complete reduction of hexavalent uranium into tetravalent uranium and maximum fluoridation of the uranate used as the starting material. The reduction may be carried out between 250 and 850°C, however, a temperature between 500 and 600°C is preferable. The reducing agent is selected from hydrogen, carbon monoxide, methane, lighting gas, and ammonia. The process may be carried out in either a fixed or fluidized bed wherein the uranate particles for the latter are between 75 and 400 microns. (N.W.R.)

Separation Processes

20783 (AERE-R-3550) THE PRODUCTION OF PURE STABILISED URANIUM 233 DIOXIDE. L. Airey, G. M. Gillies, B. A. J. Lister, A. G. Wain—N. J. Keen, ed. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1961. 19p.

A description is given of the purification, by butex extraction, of approx. 30g. of U-233 as nitrate, followed by an account of experiments made to ascertain the optimum condition for precipitation of ammonium diuranate, its ignition, and reduction by hydrogen, to give an oxide which does not re-oxidize on exposure to air. The purified uranium was processed to give an oxide of composition $UO_{2.03}$, suitable for reduction to metal with calcium. Two similar operations are discussed for 400- and 700-g quantities of U-233 as nitrate, separated by solvent extraction from irradiated thorium. The purification by precipitation and conversion on a 100g. batch scale to a stable uranium dioxide suitable for reduction to metal powder is discussed. (auth)

20784 (CEA-1823) ETUDE DE SOLUBILITE DU MOLYBDENE EN MILIEU NITRIQUE. (Study of the Solubility of Molybdenum in Nitric Solutions). P. Faugeras, C. Lheureux, and P. Leroy (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 22p.

The use of U—Mo alloys in reactors poses the problem of the chemical treatment of these nuclear fuels. The molybdenum is scarcely soluble in the nitric solutions used during the treatment, and may precipitate during operations. In order to forestall these incidents, a study was made of the solubility of molybdenum as a function of temperature, acidity, and uranium concentration. The influence of the presence of ferric ions on this solubility was also studied. (auth)

20785 (CNEN-2) DESIGN OF SERIES PULSE COLUMNS PILOT PLANTS APPLIED TO THE RECOVERY AND SEPARATION OF FISSION PRODUCTS. II. THEORETICAL SOLUTION OF A PROBLEM CONCERNING THE SEPARATION OF RARE EARTHS AT A HIGH DECONTAMINATION FACTOR AND RECOVERY. F. L. Salvetti and S. Santoli (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Oct. 1960. 12p.

Possibility of rare-earth separation by means of a dioctylphosphoric acid (HDEHP) is examined. The use of such a solvent for its efficiency and because of specified advantages is suggested. High decontamination joined with good recovery is shown to be obtainable. (auth)

20786 (CNEN-3) DESIGN OF SERIES PULSE COLUMNS PILOT PLANTS FOR LIQUID-LIQUID EXTRACTION. III. CALCULATION AND PRACTICAL REALIZATION OF A PLANT WITH REMOTE CONTROL AND RADIATION SHIELDING. F. L. Salvetti and S. Santoli (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Oct. 1960. 47p.

The design is exposed of a series pulse columns pilot plants with remote control and radiation shielding. The project includes the choice of the remote control units, of the electrical setup for them, and the installation in a hot cell. Data are given of the plant built up. Pressure drops analysis through a series connected columns plant is made. (auth)

20787 (DP-588) REPROCESSING OF POWER REACTOR FUELS. Fourteenth Quarterly Progress Report, January 1—April 1, 1961. J. Harding Owen, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1961. Contract AT(07-2)-1. 12p.

Aluminum metal anodes were found to dissolve electrolytically in nitric acid at a rate of 0.37 g per ampere-hour; mercuric ion did not catalyze the rate of dissolution of the aluminum anode. Stainless steel dissolved electrolytically in 2 to 6M HNO_3 at a rate of 0.58 g per ampere-hour. In 0.1 to 2M HNO_3 the current utilization decreased because of competing side reactions, one of which is the anodic production of O. Irradiated UO_2 power fuel elements clad in stainless steel were dissolved electrolytically in nitric acid, and the U and Pu in this solution were successfully processed by solvent extraction. Stainless steel and Al were dissolved in a prototype, 5000-ampere electrolytic dissolver. Corrosion of the dissolver vessel by either stray currents or nitric acid containing dissolved stainless steel was insignificant. Coupons that were attached to the dissolver and removed after 200 hours dissolution time, including 100 hours at 85°C, indicated less than 1 mil per year corrosion. (auth)

20788 (HW-61594) COMPARATIVE EVALUATION OF THE AGITATED TROUGH AND FLUIDIZED BED DENITRATION PROCESSES FOR APPLICATION TO THE HANFORD NPF PROGRAM. B. F. Campbell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1959. Contract AT(45-1)-1350. 11p.

A technological and economic comparison is given of two possible ways of calcining UNH to UO_3 in the final uranium processing step in the Hanford NPF reprocessing program in agitated troughs and in fluidized beds. Cost estimates indicate that a cost difference of $5,000 to $88,000 may exist in favor of the agitated trough system. Since the technology of agitated troughs is well developed, it is recommended that agitated troughs be used in the NPF program for UNH denitration. (D.L.C.)

20789 (IDO-14521) A STUDY OF THE FEASIBILITY OF A SMALL SCALE REPROCESSING PLANT FOR THE DRESDEN NUCLEAR POWER STATION. H. Schneider, R. D. Fletcher, J. W. Codding, R. G. Bearden, E. E. Ericson, S. J. Horn, M. E. Jacobson, R. F. Murray, and E. L. Rowe (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 28, 1961. Contract AT(10-1)-205. 158p.

The technical and economic feasibility of a small-scale reprocessing plant suitable for handling the fuel load from the Dresden reactor was evaluated and found to be good. The conceptual design of a plant is described, the associated hazards are assessed, cost data are presented, and development requirements are described. (D.L.C.)

20790 (ORNL-3071) RECOVERY OF URANIUM FROM AMINES BY THE HIGH NITRATE—WATER STRIPPING METHOD. F. G. Seeley and D. J. Crouse (Oak Ridge National Lab., Tenn.). June 8, 1961. Contract W-7405-eng-26. 34p.

A method was developed for recovering uranyl nitrate from amines as a liquid rather than a solid concentrate. This procedure offers potential cost savings by simplifying the over-all uranium mill—refinery flowsheet. The process involves treatment of the amine extract with calcium nitrate solution to convert the uranium in the solvent to the nitrate complex, stripping the uranium with water or dilute nitric acid, and recovering the nitrate from the solvent for recycle by contact with a lime slurry. Reagent costs for the stripping process were estimated at 4.9¢ per pound of U_3O_8. (auth)

20791 (ORNL-3109) AN INVESTIGATION OF THE TRANSFER OF URANYL NITRATE ACROSS THE WATER

TRIBUTYL PHOSPHATE INTERFACE BY THE METHOD OF PHOTOGRAPHIC PHOTOMETRY. C. V. Chester (Oak Ridge National Lab., Tenn.). June 8, 1961. Contract W-7405-eng-26. 75p.

The resistance of the water–tributyl phosphate (TBP) interface to diffusion of uranyl nitrate was investigated by a photographic photometric technique. The resistance was below the limit of detectability in the experiments, even with a surface-active agent present in the system. The sensitivity of the experiments established an upper bound for the interfacial resistance to diffusion equivalent to that of a 25-μ film of TBP under steady-state diffusion. The results indicated that the rate-limiting step in solvent extraction of uranyl nitrate from water by TBP is transfer of the diffusing species between the interface and the bulk phase rather than across the interface. In the experiments a steady-state concentration profile was established across an interface by providing a source of uranyl nitrate on one side and a sink on the other in a special cell. Uranyl nitrate diffused along the concentration gradient and hence across the interface. A resistance to diffusion by the interface would be manifest as a departure from equilibrium of the uranyl concentrations immediately adjacent to and on either side of the interface. Accurate values of the interfacial concentrations at steady state were obtained by extrapolating the profile obtained from a few point measurements on either side. The profiles were computed from densitometric measurements of photographic images of the column which were compared with similar images of standard solutions. (auth)

20792 IMPROVED 2-THENOYLTRIFLUOROACETONE EXTRACTION METHOD FOR RADIOZIRCONIUM. J. Frederic Marsh, William J. Maeck, Glenn L. Booman, and James E. Rein (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem., 33: 870-2(June 1961).

Radiozirconium is extracted from spent reactor fuels by reaction with 2-thenoyltrifluoroacetone. The various species of zirconium are converted by this reaction into extractable form with xylene. The interfering element, radioiodine, is removed by tripping the organic phase with nitric-hydrofluoric acid. (auth)

20793 SEPARATION OF COPPER, NICKEL, AND COBALT BY ION EXCHANGE RESINS. Tetsuro Katsura (Kosaka Mine, Dowa Mining Co., Ltd., Japan). Bunseki Kagaku, 10: 370-3(Apr. 1961). (In Japanese)

Separations of copper from nickel, and of copper from cobalt are described, using cation exchange resins. The apparatus, resin, and separatory technique are outlined. .5M sodium chloride is used for liberation of nickel and cobalt from the resin. Nickel and cobalt are determined titration with ethylenediamine tetraacetic acid solution, using murexide as an indicator. Also, the distribution coefficients of several metals as effected by the change in concentrations of sodium thiosulfate are determined. The metals adsorbed by the ion exchange resin are liberated by sodium thiosulfate solution, in the order Cu–Cd–Pb–Zn, while Ni, Co, Mn, Al, Fe, Ca, and Ba are extremely difficult to liberate. (auth)

20794 CHROMATOGRAPHIC SEPARATION OF URANIUM FROM IRON AND THORIUM WITH HYDROXAMIZED FILTER PAPER. Shigehiko Hayashi and Keiya Kotsuji (Fukui Univ., Japan). Bunseki Kagaku, 10: 392-6(Apr. 1961). (In Japanese)

Filter paper is oxidized with nitrogen dioxide and hydroxamized with hydroxylamine. Uranyl ions give a yellow color and ferric ions give a brown color on this hydroxamized paper. Uranium (30 to 150 μg) is separated as a yellow band from iron (<1 mg) and thorium (<250 μg) by ascending chromatography on a strip of hydroxamized paper with 2.5% ammonium carbonate solution as a developer. After development for 180 min the band is removed, the separated uranium is extracted with dilute hydrochloric acid from the strip, and determined spectrophotometrically with neothorone using 600 mμ light. (auth)

20795 INVESTIGATION OF THE EXTRACTION OF THE COMPLEXES OF URANIUM(VI) WITH DIBENZOYLMETHANE. V. Moučka and J. Starý (Czech Technical Univ., Prague). Collection Czechoslov. Chem. Communs., 26: 763-71(Mar. 1961). (In German)

The dissociation constant, distribution coefficient, and solubility of dibenzoylmethane in water, carbon tetrachloride, benzene, and chloroform were determined. The extraction of U(VI) with dibenzoylmethane solutions in these solvents was investigated as functions of pH and U or dibenzoylmethane concentration. It was found that in the aqueous phase a complex of the type $UO_2A_n(OH)_p(HA)_r$ is formed and that the extraction follows the scheme $UO_2^{2+} + 3(HA)_{org} \rightarrow (UO_2A_2HA)_{org} + 2\,H^+$. The equilibrium constants of this reaction are 3.30×10^{-5} for CCl_4, 7.57×10^{-5} for C_6H_6, and 9.55×10^{-5} for $CHCl_3$. The approximate value of distribution coefficient of the neutral complex UO_2A_2HA was calculated, and a direct relationship was found between this value and the distribution coefficient for dibenzoylmethane. (tr-auth)

20796 OPTIMIZATION OF RADIONUCLIDE REMOVAL FROM LOW-LEVEL PROCESS WASTES BY THE USE OF RESPONSE SURFACE METHODS. D. A. Gardiner and K. E. Cowser (Oak Ridge National Lab., Tenn.). Health Phys., 5: 70-8(1961).

The principles of response surface methodology, and in particular the method of the path of steepest ascent, were employed in an attempt to discover those combinations of dose of Grundite clay, particle size of clay, excess soda ash, and proportion of stoichiometric requirement for lime, which will remove the greatest amounts of Cs^{137} and Sr^{90} from process wastes. The method of steepest ascent is a relatively new statistical technique which is applicable to experimentation in which the variables are measurable on a continuous scale. As such it is particularly useful for optimizing chemical processes. A successful application of the technique to the optimization of radionuclide removals by a chemical process is described. Laboratory experiments performed in accordance with these principles led to combinations of the treatment variables which remove up to 95% of the Cs^{137} and 96% of the Sr^{90}. The largest removal of Cs^{137} occurred at 600 ppm clay of 200-mesh, 470 ppm of excess soda ash and 1.4 times the stoichiometric amount of lime. The removal of Sr^{90} was largest at 360 ppm clay of 200-mesh, 520 ppm excess soda ash and 2.5 times the stoichiometric amount of lime. (auth)

20797 A NEW METHOD FOR THE DETERMINATION OF PARTITION COEFFICIENT OF TRI-n-BUTYL PHOSPHINE OXIDE BETWEEN TOLUENE AND AQUEOUS HYDROCHLORIC ACID. Tomitaro Ishimori and Takeo Fujino (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 276-83(Apr. 1961). (In English)

Tri-n-butyl phosphine oxide (TBPO) may be used as an extractant for many inorganic ions; it has the disadvantage, however, of dissolving into the aqueous phase to some extent. The partition coefficient of TBPO between toluene and 0.5, 1, and 2M hydrochloric acid is determined using the solvent extraction technique with a radioactive indicator (Zn^{65}). It is found that the trace amount of Zn is comparatively well extracted into TBPO–toluene solution in this

acidity range, and the Zn distribution ratio is nearly proportional to the square of TBPO concentration in the organic phase. The concentration of TBPO may therefore be obtained, by measuring the distribution ratio for Zn^{65} between an unknown concentration of TBPO and a known concentration of hydrochloric acid. Based on this technique, three methods are proposed and discussed. The results are compared with those obtained by activation analysis of TBPO using P^{32}. Although the determination of partition coefficient by solvent extraction technique appears to be rather inferior to that using P^{32} labeled TBPO, the new method has the advantages of simplicity and rapidity. (auth)

20798 SEPARATION OF POTASSIUM, RUBIDIUM, AND CESIUM CONTAINED IN SOLUTIONS OF FISSION PRODUCTS. R. Sauvagnac (Centre d'Etudes Nucleaires. Saclay, France) and U. Rosa. p.305-19 of "VII Rassegna Internazionale Elettronica e Nucleare. V Congresso Nucleare 1960. Volume Secondo." Rome, Comitato Nazionale Ricerche Nucleari, [1960]. (In Italian)

In solutions of fission products from fuel element processing, the elements Cs and Rb are present, as well as Na and K from reagents used in the processing. The procedure adopted for the separation of Cs at Saclay, which is briefly described, eliminates Na, but not K or Rb. These elements can seriously dilute the cesium to be used in the preparation of high activity gamma sources. The procedure used has three distinct phases: separation of the alkaline group of elements from the other fission products, separation of the alkaline elements from each other, and determination of K and Rb. The Raggenbass-Fisher method is used for the first phase, and the alkaline elements are separated by exchange chromatography in a cation column. The pilot installation used for the separations is briefly described. (tr-auth)

20799 ELIMINATION OF RADIOACTIVE IONS FROM WATER. F. Martinola (to Bayer A. G.). Belgian Patent 591,612. Oct. 3, 1960.

Radioactive anions, for instance I^- are eliminated from the water by precipitation with a cation exchanger charged with barium or silver. The radioactive cations (Cs^+, Sr^{++}) are similarly eliminated by an organic cation exchanger containing sulfonic and carboxyl groups. It has been found useful to keep the pH of the solution to a pre-determined value by adding, for instance, bicarbonate of soda or sodium phosphate. (EURATOM)

20800 SEPARATION OF URANIUM AND ZIRCONIUM. (to Dow Chemical Co.). Belgian Patent 592,678. Priority date, May 9, 1960.

Mixtures or alloys of zirconium–uranium are immersed into molten aluminum at 800 to 900°C. The zirconium bearing precipitate is then removed by decantation or centrifugation at 670 to 760°C. Re-cycling is advisable to obtain better elimination of zirconium. (EURATOM)

20801 SEPARATION OF THORIUM FROM LANTHANONS. William Palmer Kemp and Kenneth William Pointing (to Thorium Ltd.). British Patent 863,572. Mar. 22, 1961.

A process for the separation of a thorium salt from an aqueous feed solution containing thorium, lanthanon, nitrate, and phosphate ions, in which the feed solution is extracted with an organic solvent immiscible with water, the process being performed in the presence of ferric ions, is described. Aluminum ions may be used instead of ferric ions. The ferric ions are at least 0.89 g greater than for each gram of phosphate ions present in the feed solution. If ferric nitrate is used for adding the ferric ions then at least 7 g must be added for each gram of phosphate ions. For aluminum, the ions must be 0.5 g over each gram of phosphate ion. Tributyl phosphate is used for the organic solvent in admixture with a xylene. The feed solution is free from sulfate and chloride ions, and the solution contains from 2 to 8 molar of nitric acid, preferably 3 to 4 molar. (N.W.R.)

20802 IMPROVEMENTS IN OR RELATING TO THE RECOVERY OF CAESIUM VALUES FROM CAESIUM PHOSPHOTUNGSTATE. Thomas Victor Healy, Harold Augustus Walker, and Thomas Elwyn Edwards (to United Kingdom Atomic Energy Authority). British Patent 868,841. May 25, 1961.

A process for producing a solution containing cesium from cesium phosphotungstate, the solution being substantially free from phosphate, tungstate, and phosphotungstate ions, is described. In particular, radioactive cesium sulfate or cesium chloride is produced from an aqueous nitric acid solution of nuclear fission products by separating the cesium from the products by precipitation as cesium phosphotungstate. The cesium phosphotungstate is first dissolved in an aqueous solution of ammonia. Then barium hydroxide solution is added to the dissolved solution such that the barium is in excess of the chemical equivalent of the phosphate and tungstate in the cesium phosphotungstate. A major proportion of the excess barium is precipitated as carbonate by adding ammonium carbonate in excess and boiling the solution. The solution formed is evaporated to small bulk whereby the excess ammonia is driven off and the remainder of the barium is precipitated as carbonate. The solution is separated from the precipitate and sulfuric or hydrochloric acid is added in slight excess to the separated solution. Cesium sulfate or cesium chloride is formed when the solution is evaporated to dryness. A modification of the process for cesium sulfate consists of precipitating the excess barium hydroxide as sulfate by the addition of sulfuric acid to give a solution of pH above 3 to 4, and separating the solution of cesium sulfate from the precipitate so formed. (N.W.R.)

20803 PROCESS FOR THE SEPARATION OF THORIUM FROM LANTHANONS. Leonard George Sherrington (to Thorium, Ltd.). British Patent 869,958. June 7, 1961.

A process for the separation of thorium from a mixture containing the rare earths and in particular to a process in which the mixture is one obtained from monazite is described. An aqueous solution of thorium, rare earths, and excess sulfate ions obtained by the degradation of monazite with sulfuric acid is extracted with a solution in a water-immiscible organic liquid of an amine having an aliphatic chain containing 10 to 30 carbon atoms, the amine being one which will form a complex with the thorium and sulfate ions, the resulting organic solvent extract is washed with an aqueous solution containing chloride and sulfate ions, and the thorium is then removed from the washed organic solvent extract by extraction with an aqueous solution containing ions which displace the thorium from the amine complex. The amine is a primary alkylamine having a branched alkyl chain. The organic liquid is kerosene, xylene, toluene, benzene, or an aromatic hydrocarbon. An ammonium nitrate solution containing nitric acid is used for the extraction of the washed organic solvent extract. (N.W.R.)

20804 SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS. Cyril M. Nicholls, Ivor Wells, and Robert Spence (to Atomic Energy of Canada, Ltd.). Canadian Patent 613,891. Feb. 7, 1961.

A solvent extraction method for the treatment of neutron

rradiated uranium in order to remove plutonium and ura-
ium from the fission products and to separate the pluto-
ium from the uranium is described. The irradiated ura-
ium is dissolved in 2 to 4 N, preferable 3 N, nitric acid
o provide an aqueous acidic solution of nitrate salts of
ranium, plutonium, and fission products. The solution is
hen treated with dibutyl carbitol to extract the uranium
nd plutonium into the organic solvent phase. The organic solvent, dibutyl carbitol, is 1.8 N in nitric acid to avoid transfer of acid from the aqueous to the organic phase. The plutonium is separated from the uranium in the organic phase by extraction into an aqueous nitrate salt solution containing a reducing agent for the plutonium. The aqueous phase containing the plutonium is separated from the solvent phase. The fission products are extracted as nitrates in the aqueous phase. (N.W.R.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

20805 (ARF-3187-4) ELECTROSTATIC CLASSIFICATION OF SUBMICRON AIRBORNE PARTICLES. Progress Report, April 15 to June 15, 1961. Gerhard Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract AT(11-1)-578. ARF Project C-187. 16p.

Results are presented for a study of the basic variables affecting electrostatic classification of heterogeneous aerosols of submicron size, especially below 0.1 μ. Aerosols tested included atomized salt solutions, polystyrene latex aerosols, and gold colloids. Interference of stabilizer in the polystyrene latex aerosols was noted. (D.L.C.)

20806 (GEAP-3683) COMPILATION OF TECHNIQUES USED BY VALLECITOS RADIOACTIVE MATERIALS LABORATORY. F. A. Brandt, P. W. Mathay, and D. L. Zimmerman (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Feb. 1961. Contract AT(04-3)-189. 27p.

Equipment and techniques for remote examination of irradiated fuel assemblies applicable to the Maritime Program are described. The subjects covered are: visual and photographic examination, dimensional measurements, gamma activity scanning, fission gas release, fuel-rod void-volume determinations, density measurements, metallographic examination, and radiochemical burnup analysis. (auth)

20807 (HW-67258) NPR PROCESS TUBE TO NOZZLE FITTING EVALUATION. J. H. Fastabend (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1960. Contract AT(45-1)-1350. 43p.

A testing program was carried out in order to find a satisfactory means of joining Zircaloy-2 process tubes to front and rear carbon steel nozzles for the New Production Reactor. The results of the program are presented for nine different type joints; the rolled tubing joint and the threaded tube joint with a special G-seal design were the only ones to meet testing requirements. (D.L.C.)

20808 (HW-SA-2143) GAS LUBRICATED BEARINGS IN A NUCLEAR APPLICATION. E. C. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 30, 1961. Contract AT-(45-1)-1350. 14p.

Prepared for presentation at American Society of Lubrication Engineers–American Society of Mechanical Engineers, Joint Lubrication Conference, Oct. 17–19, 1961, Chicago.

The development and operational history of gas circulators for in-reactor gas-cooled loops which use the loop gas as the lubricant are described. Circulators incorporating hydrostatic journal-and-thrust bearings were run in the DR-1 loop with He or N_2 for a total of 9533 hr. Only minor difficulties were encountered, and bearing wear was negligible. (D.L.C.)

20809 (IDO-16624) HIGH-PRESSURE, HIGH-TEMPERATURE WATER LOOP OPERATING MANUAL. J. D. Stearns and K. S. Dawson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 25, 1961. Contract AT(10-1)-205. 153p. (WCAP-4)

The mechanical and electrical systems, design features, and general operating instructions of the WCAP-4 pressurized in-pile test loop are described. (D.L.C.)

20810 (NAA-SR-Memo-5664) A CONTINUOUSLY-OPERATED FURNACE FOR SINTERING REFRACTORIES IN HYDROGEN. S. Strausberg and T. E. Luebben (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1960. 12p.

Test of a continuously operating furnace is reported. The furnace operated for 8 months. It is concluded that the system can ensure maximum personnel safety and extended furnace life. Significant gains in furnace life were found to accrue from continuous operation. (J.R.D.)

20811 (NP-10291) ANALYSIS AND DESIGN SPECIFICATIONS FOR CRYOGENICALLY COOLED AIR SAMPLER. Final Report. H. E. Karig, R. J. Gagnon, and W. A. Bass (National Engineering Science Co., Pasadena, Calif.). Mar. 6, 1961. For Aerolab Development Co., Pasadena, Calif. Contract AF19(604)-7341. 62p. (SN-25).

The requirements for a collector of Rh^{102} particles of near-molecular dimensions and at high altitudes are discussed. The engineering analysis and design criteria in support of a cryogenically cooled air sampling and storage device for use in conjunction with the Aerobee 100 booster are presented. The collector system was designed to take a single sample over the 40 to 100 km range, or any fraction thereof, sweeping out a column 150 cm^2 in cross section. The sampler consists of a normal shock inlet discharging into a plenum chamber. From the plenum chamber the flow enters a parallel tube bundle heat exchanger immersed in liquid hydrogen. In its passage through the tubes the air gives up its heat. The phase change prevents the back pressure from becoming any higher than the vapor pressure of air at the condensation temperature and permits the storage of a large volume of air in a small space. On termination of the sampling period, the storage volume is sealed off and returned to earth by means of the standard Aerobee recovery system. (M.C.G.)

20812 (SCR-292) SPECIAL GAGE DESIGNS FOR POSITIONALLY TOLERANCED PARTS. Edward S. Roth (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 23p.

The principles of positional tolerancing technology are briefly explained and design of gages for representative parts is discussed for testing squareness, straightness, concentricity, and contour. Conversion charts for positional to bilateral (coordinate) tolerance and vice versa are included. (D.L.C.)

20813 (SCTM-280-60(51)) THEORETICAL ANALYSIS OF THE MOTION IN THE WEIGHTLESSNESS TEST FACILITY. M. D. Bennett (Sandia Corp., Albuquerque, N. Mex.). Sept. 1, 1960. 16p.

The weightlessness facility is to be used for testing instruments at constant acceleration in the range of 0.6 to 0.95 g. It consists of an instrumented piston in a 5.5-in. diam. 300-ft long vertical pipe with a reservoir, a control valve, and an air pump at the bottom of the pipe. The one-degree-of-freedom equations of motion of the piston are derived and solutions are presented. The results indicate that the piston acceleration may be maintained constant within 0.05 g for ~3.5 sec when the effective rate of opening the valve is a parabolic function of time. (D.L.C.)

20814 (ZR-1001-2) DEVELOPMENT OF A HIGH-TEMPERATURE NUCLEAR-RADIATION-RESISTANT PNEUMATIC POWER SYSTEM FOR FLIGHT VEHICLES. Monthly Progress Report No. 2, Phase 1 Reporting Period

November 5, 1960 to November 21, 1960. (Convair, San Diego, Calif.). Contract AF33(616)-17582. 14p. (AD-247654)

In material studies, the compilation of material data and a review of material development was initiated. System analysis was initiated to establish a comparison between high pressure systems powered by compressors or cryogenic gas sources, and low-pressure systems powered by direct ram air or a cryogenic gas source. The analysis is designed to permit selection of an optimum system for procurement purposes later in the program. A literature survey on component design was initiated. (J.R.D.)

20815 (CEA-tr-R-1301) LE PROBLEME DE L'INFLUENCE DES RAYONNEMENTS IONISANTS SUR L'ETAT DE DISPERSION DES AEROSOLS. (The Problem of Influence of Ionizing Radiation on Dispersion States of Aerosols). V. F. Dunskii (Dunsky) and N. S. Smirnov. Translated into French from Kolloid. Zhur., 21: 436-41(1959). 17p.

This paper was previously abstracted from the original language and appears in NSA, Volume 13, abstract no. 19766.

20816 (IG-Inf.-Ser.-60) THRUST BEARINGS. O. Gersdorfer. Translated by R. G. Evan from Konstruktion, 8: 87-94(1956). 21p.

The effective use of the hydrodynamic theory of lubrication in the construction of thrust bearings enabled designs to be made which are capable of absorbing high loads at any practical speed. The bearings, equipped with hydrodynamic lubricating wedges, are manufactured by an "exact copying" process. The danger of tilting was reduced considerably by special design and construction alterations. Formulas are given for calculating the carrying properties (M.C.G.)

20817 DEPOSITION OF AEROSOL PARTICLES IN FIBROUS FILTERS. D. G. Thomas and C. E. Lapple (Ohio State Univ., Columbus). A.I.Ch.E. Journal, 7: 203-10(June 1961).

The collection efficiency of glass fiber pads was investigated with a super cooled liquid aerosol. A filter-velocity range of 0.02 to 20 ft/sec was covered with filter pads having a bulk density ranging from 1 to 10 lb/ft^3 and a fiber diameter ranging from 1 to 30 μ. For the aerosol employed the results showed a minimum collection efficiency at a velocity of 2 to 5 ft/sec, dependent on fiber size. At the lower velocities, where diffusion is controlling, collection efficiency increased with decreased velocity; at higher velocities, where inertia is controlling, efficiency increased with increased velocity. For generalization the data were correlated in terms of dimensionless parameters which allow for the combined effects of flow-line interception, inertial interception, and diffusional deposition. Evaluation of the data in terms of existing theories of deposition indicated nominal agreement with the theory of Langmuir, as modified by Natanson, for diffusional deposition. For inertial deposition the measured collection efficiencies were considerably lower than would be predicted from the theoretical values reported by Langmuir and Blodgett for potential flow around the fibers, presumably because of the viscous-flow (low Reynolds number) conditions that prevailed in this study. (auth)

20818 ENTRAINMENT FROM A SUBMERGED COMBUSTION EVAPORATOR. George Rey (General Electric Co., Richland, Wash.). A.I.Ch.E. Journal, 7: 299-302(June 1961).

Sodium ion was used as a tracer. By measuring the ratio of the sodium concentration in the pot to that in the condensate the entrainment removal performance of the evaporator system was studied under various conditions. It was observed that the log of the concentration ratio decreases with an increase in the temperature of the gaseous products of combustion as they emanate from the combustion chamber into the solution. This is attributed to the fact that a greater amount of fine (<5 μ) droplets of entrainment are formed in the evaporator as the temperature of the gases increases. (auth)

20819 γ-UNIT FOR CHRONIC IRRADIATIONS IN RADIOBIOLOGICAL EXPERIMENTS. A. V. Bibergal' (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 713-16 (1960).

The design is described of a Co^{60} γ irradiation unit for the exposure of small laboratory animals. (C.H.)

20820 LIQUID HYDROGEN TRANSFER PIPES AND LEVEL REGULATION SYSTEMS. M. Marquet, P. Prugne, and P. Roubeau (C. E. N., Saclay, France). Proc. Intern. Congr. Refrig. 10th Congr., Copenhagen, 1959, 210-14 (1961). (In French)

A description is given of the transfer pipes and level regulation systems used in liquid hydrogen Dewars. The transfer pipes have a knee-joint system for quick and accurate positioning of the plunging Dewar rods. The plunging rods have a combined valve and rod. The valves are activated by bulb pressure, automatic solenoid, or hand control. The latter allows intermittent filling. The level regulation system is composed of maximum and minimum level bulbs which automatically control the liquid hydrogen valve. (N.W.R.)

20821 SWITCHING SYSTEM OF GAS SAMPLING CIRCUITS FOR BURST SLUG DETECTION. R. Cochinal, A. Roguin, and R. Donguy (to C.E.A.). Belgian Patent 576,884. Priority date, Mar. 28, 1958.

The gas sampling circuits are grouped and automatically switched one after the other onto a series of monitoring detectors. When a certain activity level is detected, the faulty channel is isolated and monitored constantly by one of another set of detectors. Switching is entirely automatic and synchronized by means of an elaborate system of rotating cams and spring contacts. (EURATOM)

20822 APPARATUS FOR STORAGE OF RADIOACTIVE NEEDLES. Lloyd Asquith Winston Ewart Kemp and Joseph Oakley Leach (to H. M. Hobson, Ltd.). British Patent 869,940. June 7, 1961.

A safe is described in which radioactive needles can be stored in appropriate storage chambers and which permits ready extraction of individual needles when they are required for use. Hospital personnel shall not be exposed to harmful radiation. The safe will normally include storage chambers each for storing needles of one particular type. The needles range from $\frac{3}{8}$ inch to a maximum of 3 inches and to simplify storage all needles are placed in containers of identical length. These containers may be of two diameter sizes, $\frac{1}{4}$ and $\frac{5}{32}$ inch. The safe consists of an inlet passage down which the containers may be slid endwise and in succession into the upper end of the storage chamber, a gate at the entrance of the chamber for aligning each entering container and ensuring that it will fall flat on the bottom or on to a container beneath it, a slide operable from the front of the safe to withdraw the bottom container from the stack in the storage chamber, and mechanism for extracting the containers. (N.W.R.)

Heat Transfer and Fluid Flow

20823 (AERE-R-3680) ANALYSIS OF ANNULAR TWO-PHASE FLOW: APPLICATION OF THE DUKLER ANALYSIS TO VERTICAL UPWARD FLOW IN A TUBE. G. F. Hewitt (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 41p.

Dukler's analytical treatment of downward, annular two-phase flow is adapted to upward flow. Both fluid dynamics and heat transfer are considered. Diagrams illustrating two-phase flow calculations are presented along with tables of numerical solutions. (D.L.C.)

20824 (CF-61-4-61) AN EVALUATION OF THE PRESENT STATUS OF SWIRL-FLOW HEAT TRANSFER. W. R. Gambill and R. D. Bundy (Oak Ridge National Lab., Tenn.). Apr. 24, 1961. 19p.

Available swirl-flow data for pressure drop, nonboiling and boiling heat transfer, and burnout were collected and compared on common bases. Though different sets of data are in some disagreement, semiquantitative over-all trends are discernible. It is shown that swirl flow allows attainment of greater heat transfer rates under a variety of conditions, both without boiling and at burnout, that are characteristic of axial flow at the same pumping power. (auth)

20825 (GEAP-3214) VAPOR VOIDS IN FLOW SYSTEMS FROM A TOTAL ENERGY BALANCE. E. E. Polomik (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1959. 31p.

Calculations of vapor voids and instability threshold are made for a boiling system on the basis of a total energy balance. The results compare well with steam–water systems data in the pressure range of 114 to 2000 psia; a difference of 0.08 to 0.12 low was observed in the calculated vapor voids and is ascribed to lack of thermodynamic equilibrium in the flow process. (D.L.C.)

20826 (JAERI-1017) HYDRODYNAMIC STUDY OF BURN-OUT IN BOILING. Report No. 17. Kinich Torikai (Japan Atomic Energy Research Inst., Tokyo). Jan. 1961. 48p.

The burn-out mechanism, by which a heating surface is melted down in the high-heat flux as the heat transfer coefficient is suddenly decreased, is investigated on the basis of hydrodynamic aspects. A completely vaporized area is created, when bubbles in boiling grow from the nucleates of bubbles on the heating surface, the bubbles are detached from the surface, and the growth of the bubbles ends. A fluid-flow resistance between the fluids occur, when the vapor rises in the area and the liquid of the same flow-rate with that of the vapor comes down. When the force, necessary to overcome the fluid-flow resistance, is not given to the fluids, there will be a limit to the flow rate. A semi-theoretical analysis was made in pool-boiling. An experiment was made on the counter flow between air and water. In consequence, it was recognized that there are limits in the flow rate and that the calculated limit values would be the same with the heat-flux in burn-out. In forced-circulation boiling, a semi-theoretical analysis was made and the equation of the maximum heat flux, $q_{B.O.} = u_m \gamma p(\lambda/8)(1-A_v)$, was obtained, under the assumption that burn-out mostly occurs when the flow-rate of the liquid coming to the heating surfaces is less than that of the vapor going out of the surface when forced circulation in boiling makes a kind of turbulent diffusion. Maximum heat-flux equations for various conditions of the flow and heating surface were introduced, and were found in good agreement with the data of many experiments on the forced-circulation boiling of water. (auth)

20827 (LAMS-2551) A PROPOSAL FOR THE USE OF THE METHOD OF CHARACTERISTICS AS A CONDITION ON THE NUMERICAL SOLUTIONS OF TWO-DIMENSIONAL LAGRANGIAN ISENTROPIC FLOW. Christian D. Anderson (Los Alamos Scientific Lab., N. Mex.). Apr. 1961. Contract W-7405-ENG-36. 38p.

A derivation is given of the Lagrangian differential equations for two-dimensional, time-dependent, isentropic flow. Discussions are included on the following: the method of characteristics including the concepts of domain of dependence and region of influence; application of the method to the differential equations to obtain the equation of the cone of vectors $\vec{\xi}$ normal to the characteristic surfaces at any point P in x, y, t space; the relation between the cone of normal vectors and the characteristic cone at P; and a preliminary proposal for the application of characteristic cones as a condition on the numerical solution of the Lagrangian differential equations. It was found that the $\vec{\xi}$ cone was an elliptical conical surface for the two-dimensional, time-dependent, isentropic Lagrangian differential equations. (auth)

20828 (NP-10317) FILM BOILING ON HYDRODYNAMIC BODIES. Research Note 37. Walter S. Bradfield, Robert O. Barkdoll, and John T. Byrne (Convair Scientific Research Lab., San Diego, Calif.). Dec. 1960. 35p.

Free and forced convection quenching studies of hydrodynamic shapes are presented. Effects of subcooling and surface condition on heat flux and vapor layer stability are included. Motion picture studies of characteristics of vapor-liquid interface configurations are discussed. These include vapor layers generated by sublimation and with a chemically reacting surface in combination with film boiling. Forced convection heat transfer and friction drag measurements in water are presented and compared with theoretical predictions. Large friction drag reductions were observed. (auth)

20829 (NP-tr-676) HEAT EXCHANGE DURING THE FLOW OF LIQUID METAL IN THE LAMINAR AND TRANSITION REGIONS. B. S. Petukhov and A. Ya. Yushin. Translated from Doklady Akad, Nauk S.S.S.R., 136, 1321 (1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 15729.

20830 MASS TRANSFER WITH LIQUID LITHIUM IN CIRCULAR CONDUITS. William N. Gill, Richard P. Vanek, and C. S. Grove, Jr. (Syracuse Univ., N. Y.). A.I.Ch.E. Journal, 7: 216-20(June 1961).

Forced convection mass transfer between circular tubes and liquid lithium was experimentally investigated over a range of Schmidt numbers from 40 to 57 and Reynolds numbers from 5550 to 22500. Information concerning the mechanism for mass transfer was obtained by measuring local solution and deposition rates as a function of distance along the tubes. Observed entrance effects for the solution process suggest that it involves the parallel mechanisms of diffusion through a solid film and through occluded liquid in grain boundaries. It is indicated that the relative contributions of these processes change with increasing temperature. A j-factor correlation of existing liquid metal mass transfer data for fully developed conditions in circular conduits is presented and indicates that an exponent of 0.112 for N_{Re} best represents the data. (auth)

20831 THEORETICAL ANALYSIS OF HEAT TRANSFER TO GASES IN SMOOTH, ROUND TUBES UNDER CONDITIONS OF TURBULENT FLOW AND HIGH FLUX. J. D. Seader and H. Wolf (Rocketdyne, Canoga Park, Calif.). ARS (Am. Rocket Soc.) J., 31: 650-2(May 1961).

A theory for heat transfer to gases in cylindrical tubes under conditions of turbulent flow and high heat flux is developed. The effects of changes in the physical properties of the gas caused by the high radial temperature gradients are taken into account. Correlations are shown between the bulk Nusselt number, the bulk Reynolds number, the friction and heat transfer, and the ratio wall temperature/bulk temperature, using He as an example. (T.F.H.)

20832 HEAT TRANSFER IN LOW PRANDTL NUMBER FLOWS WITH VARIABLE THERMAL PROPERTIES. D. K. Edwards (Univ. of California, Los Angeles) and D. M. Tellep. ARS (Am. Rocket Soc.) J., 31: 652-4(May 1961).

The heat transfer properties of a low speed, two-dimensional fluid flow are considered. The Prandtl number is restricted to values very near zero, but the thermal properties are allowed to be variable. It is noted that the technical applications of such systems are limited to liquid metals. The heat transfer properties with constant and variable thermal properties are compared under free stream conditions. (T.F.H.)

20833 SIMULTANEOUS HEAT AND MASS TRANSFER IN FREE CONVECTION. W. R. Wilcox (Univ. of California, Berkeley). Chem. Eng. Sci., 13: 113-19(1961). (UCRL-8807)

The problem of simultaneous heat and mass transfer in laminar free convection from a vertical flat plate is investigated theoretically. An integral method is used to find solutions for zero wall velocity and for a mass-transfer velocity at the wall, with the wall either insulated or held at a constant temperature. The zero-wall-velocity solution is compared with existing solutions and data for simultaneous heat and mass transfer, heat transfer alone and mass transfer alone. (auth)

20834 HEAT TRANSFER FROM A LONGITUDINAL FINNED SURFACE TO ORGANIC COOLANT. S. Sudar and C. R. Davidson (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 9(June 1961).

20835 HEAT TRANSFER TO SUPERHEATED STEAM. J. B. Heineman (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 9-10(June 1961).

20836 HEAT TRANSFER ACROSS VERTICAL WATER LAYERS. R. Sandberg, L. Efferding, and A. A. Bishop (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 10-11(June 1961).

20837 STEAM-WATER SEPARATION ABOVE A TWO-PHASE INTERFACE. J. F. Wilson, R. J. Grenda, and J. F. Patterson (Allis-Chalmers Mfg. Co., Milwaukee). Trans. Am. Nuclear Soc., 4: No. 1, 46(June 1961).

20838 ACCURACY AND CONVERGENCE TECHNIQUES FOR IMPLICIT NUMERICAL SOLUTION OF THE DIFFUSION EQUATION FOR TRANSIENT HEAT TRANSFER. B. Kaplan and N. Clark (General Electric Co., Cincinnati). Trans. Am. Nuclear Soc., 4: No. 1, 80-1(June 1961).

20839 PROCESS FOR HEAT TRANSFER BY MEANS OF ORGANIC LIQUIDS. (to Shell Internationale Research). Belgian Patent 582,283. Priority date, Sept. 5, 1958.

A new organic coolant for a nuclear reactor is proposed; it consists of 1,3,5-triphenylbenzene by itself or mixed with an aromatic hydrocarbon boiling between 350 and 400°C, such as terphenyl, diphenyl, and/or monoisopropyldiphenyl. (EURATOM)

Instrumentation

20840 (AD-239752) ELECTRON-NUCLEAR INTERACTION IN RUBY AND ITS EFFECT ON THE RUBY MASER. George Makhov, Robert Terhune, John Lambe, and Lloyd Cross (Michigan. Univ., Ann Arbor. Willow Run Labs.). July 1960. 14p.

It was found that changes in the polarization of the Al^{27} and Cr^{53} nuclei in ruby affect markedly the absorption or emission of microwave power associated with the electron-spin resonance of the Cr^{3+} ion. This effect was used to observe weak nuclear resonances and to change markedly the operating characteristics of the maser. (auth)

20841 (AFOSR-388) A GENERAL ANALYSIS OF OPTICAL, INFRARED, AND MICROWAVE MASER OSCILLATOR EMISSION. J. R. Singer and S. Wang (California. Univ., Berkeley. Electronics Research Lab.). Mar. 21, 1961. Contract AF49(638)-102. 10p.

A generalization is presented of equations governing coherent emission from quantum mechanical amplifiers (microwave, infrared, and optical masers) using either electric or magnetic dipole transitions. It was found that an amplitude modulation of the output is to be expected from all maser oscillators excepting those in which excited atoms are supplied at a notably greater rate than the depopulation rate caused by coherent induced emission. The analysis also suggests that an energy population inversion of electric dipole moments can be performed using coherent light sources in the same manner as with magnetic dipole moments. It appears that modulation of infrared or optical masers may be easily accomplished by varying the population of excited states through control of the pumping energy. (B.O.G.)

20842 (AMC-TR-61-7-534) DRY CIRCUIT TESTS AND TEST EQUIPMENT FOR ACCEPTANCE TESTING OF RELAYS FOR LOW LEVEL APPLICATION. Final Engineering Report, September 18, 1958-September 18, 1960. (Union Switch and Signal. Div. of Westinghouse Air Brake Co., Pittsburgh). Mar. 1961. Contract AF33 (600)-33403. 101p.

The general performance and reliability of a relay with respect to surety of contact make appeared to depend upon two main factors: design and manufacturing processes. Particulate matter apparently caused the major portion of contact failures. That is, the number of failures for a given period of operation depended upon the amount of contamination in the relay and its random movement. Design can reduce or eliminate the problem due to particle contamination by insuring the high contact force and the relatively large amount of contact wipe required to maintain clean contact interfaces. Proper material selection for the moving parts will help to maintain wear product contamination at a minimum value. Manufacturing processes can help produce a reliable product by reducing to a minimum the contamination included in each unit during its construction. It was important that those tests which attempted to determine contact reliability maintain operation in the low level area for each total contact operation to obtain the most accurate results; thus, the electrical test parameters had to be as low as possible. Four different makes of relays, thought to be representative for hermetically sealed relays, were selected for this study and test. (auth)

20843 (CNEN-44) LO SPETTROMETRO A NEUTRONI POLARIZZATI DEL CENTRO DELLA CASACCIA DEL C.N.E.N. (The Polarized Neutron Spectrometer of the Centro di Studi Nucleari Della Casaccia). E. De Agostino, F. Marsili, and A. Paoletti (Italy. Comitato Nazionale per L'Energia Nucleare, Ispra). Jan. 1961. 16p.

A spectrometer for polarized neutrons built to be operated at the TRIGA Mark II reactor of the "Centro di Studi Nucleari della Casaccia" is described. The measured

polarization of the thermal neutrons is better than 97% and the flipping efficiency is better than 96%. (auth)

20844 (DP-582) LABORATORY EVALUATION OF AN AUTOMATIC GAS CHROMATOGRAPH. David L. West (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1961. Contract AT(07-2)-1. 15p.

Laboratory tests demonstrated that a commercially manufactured automatic gas chromatograph was suitable for the in-line determination of D_2, O_2, N_2, and CO_2 in the helium blanket gas of a nuclear reactor. Standard deviations obtained were 1% of full scale for full-scale ranges between 0.2 mol % and 2.0 mol % and 0.2% of full scale for ranges greater than 2.0 mol %. The instrument can be operated on full-scale ranges as low as 0.2 mol % D_2, 0.03 mol % O_2, 0.03 mol % N_2, and 0.1 mol % CO_2. (auth)

20845 (GEAP-3689) FAILURE MONITORING IN A SERVO CONTROL ROD DRIVE SYSTEM. R. A. Hamilton (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 23, 1961. 15p. (R61APE-32)

An investigation was undertaken to analyze the effect of synchro failure in a servo system, and to develop a reliable monitoring system to warn of the failure. Because servo systems have an inherent deficiency in the case of component failure that can cause uncontrolled motion of the servo mechanism, APED sought for a reliable monitoring system to annunciate such a failure. The solution adopted compares the demanded mechanism position to the actual position, using synchros separate from those in the servo system. The failure monitoring systems proposed by synchro manufacturers indicated a lack of analysis of the effect of failures at certain critical angular displacement of the synchros. It is recognized that the solution devised by APED under pressure of a limited time schedule may not be applicable to other servo systems employing synchros, but it is hoped that the analysis of cause and effect presented herein will be a substantial help in finding other suitable solutions. (auth)

20846 (HW-SA-2140) A REPRODUCIBLE PRECISION POLYETHYLENE LONG COUNTER FOR MEASURING FAST NEUTRON FLUX. J. De Pangher (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 3, 1961. Contract W-31-109-Eng-52. 35p.

Presented at the Meeting of the American Physical Society, Washington, D. C., April 24–27, 1961.

A reproducible precision polyethylene long counter for measuring fast neutron flux is described. A diagram of the final model, which was developed after two earlier models were built and tested, is included. Design and testing of all models are described. (J.R.D.)

20847 (HW-SA-2165) AN ADIABATIC CALORIMETER FOR HIGH PRECISION SOURCE STANDARDIZATION AND DETERMINATION OF W (AIR). I. T. Myers, W. H. LeBlanc, and D. N. Fleming (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) and H. O. Wyekoff (National Bureau of Standards, Washington, D. C.). Mar. 1, 1961. Contract AT(45-1)-1350. 16p.

The measurement of the energy output of a Co^{60} source with a total absorption calorimeter is discussed. An adiabatic calorimeter designed for high precision source standardization is described. The bath temperature control circuit and the thermistor resistance measuring circuit are shown. All resistance changes and heat capacity measurements were corrected to a standard thermistor resistance. Correction for energy escaping from the calorimeter was made by using an ionization chamber instrument to measure the leakage flux. The source activity of a National Bureau of Standards Co^{60} source was found to be 0.5012 ± 0.0020 curies. The exposure dose rate was measured as 0.756 roentgens per hour. The energy to produce an ion pair in air was calculated to be 33.84 ± 0.34 ev. (M.C.G.)

20848 (JINR-P-445) THE IMAGE ORTHICON AS IMAGE AMPLIFIER AT LOW LEVEL. T. Tanasescu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 8p.

The use of a television system for recording faint luminescent images which last for a very short interval of time (10^{-8} or 10^{-7} sec) is discussed. It was determined that for the case of an image orthicon working with a normal scanning of 625 lines and 25 pictures/sec the illumination threshold is 16 times lower than that necessary for the most sensitive photographic film. The main physical processes encountered in the operation of an image orthicon were studied. An attempt was made to lower the sensitivity threshold of the normal image orthicon by increasing the scanning speed. (M.C.G.)

20849 (LMSD-325500) PYROELECTRIC TRANSDUCERS FOR HEAT-TRANSFER MEASUREMENTS. T. A. Perls and J. J. Hartog (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1961. 19p.

The state of the art for heat-transfer measurements is briefly reviewed. It is shown that heat-transfer rate may be measured with extremely short response times by the use of a variety of temperature-sensing devices followed by a simple electrical differentiator. Theoretical considerations are presented for pyroelectric ceramic transducers, and it is shown that these sensors constitute a particularly simple type of temperature-measuring device with differentiation. Evaluation and calibration procedures, applications, advantages, limitations, as well as typical circuitry and installations are discussed. (auth)

20850 (NP-10220) AN EVALUATION OF THE STABILITY AND ACCURACY OF A BREADBOARD MODEL OF A CESIUM GAS CELL ATOMIC FREQUENCY STANDARD. Technical Memorandum No. 747. M. Arditi (ITT Labs. Div. of International Telephone and Telegraph Corp., Nutley, N. J.). Jan. 1958. 107p.

A description is given of a breadboard model of a cesium gas cell atomic frequency standard which was evaluated for stability and accuracy. Short-time stability of ±2 to 4 parts in 10^{10}, long-time stability of ±1 part in 10^{10}, and accuracy of ±3 to 4 parts in 10^{10} were measured. Performances an order of magnitude better are predicted. The design of the gas cell lends itself quite easily to packaging. (auth)

20851 (NP-10264(p.161-72)) THE EFFECTS OF COLD WEATHER. PART I. THE EFFECTS OF LOW TEMPERATURE ON RADIAC INSTRUMENTS. J. T. Flynn (Canada. Defence Research Board).

The effects of low temperature on the electrical properties of radiac instruments are discussed, particularly for high-range portable survey meters. Three main types of circuitry used in survey meters are linear scale saturated chamber instruments, log scale saturated chamber instruments, and unsaturated chamber log scale instruments. Possible low-temperature effects are discussed for each type. Geiger tube instruments and dosimeters are also considered briefly. (D.L.C.)

20852 (PAN-208/XV) THE LIFE-TEST OF A G-M HALOGEN COUNTER TYPE BOS-4. J. Lesiński and W. Surwiłło (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 11p.

A general criterion for determining the life-test parameter for a G-M counter is given. The construction and process of production of the investigated halogen counter, type BOS-4 are described. The methods of life-test measurements for G-M counters as well as the results of life-test investigations of the halogen counters, Type BOS-4, are discussed. (auth)

20853 (SC-4573(RR)) DEVELOPMENT OF DESIGN CRITERIA FOR RELAYS. Final Report Covering Period February 1, 1960 to January 31, 1961. (Oklahoma State Univ., Stillwater. School of Electrical Engineering). May 1961. 68p. For Sandia Corp., Albuquerque, N. Mex.

Work carried out in the establishment of a general design technique for a class of relays of the d-c magnetic actuator type is discussed. To obtain numerical values for the variables or parameters used to describe a relay, it was necessary to develop a set of design equations. Experimental measurements on a number of relays indicated that the pick-up time may be predicted by solving the differential equation of the resistance-inductance-type circuit where saturation is negligible. The technique used to arrive at some reasonably accurate expression for the armature transit time involved an interactive procedure using both the electrical and mechanical system equations. A compilation is presented of the equations or relationships needed in the determination of a design along with an explanation of the terms and symbols used. A specific example of the developed design procedure is included. An evaluation was made of the relay map or design technique that was developed and an example of its use is given. (M.C.G.)

20854 (SCTM-94-61(24)) MILLIMICROSECOND SAMPLING. N. J. Elliott and R. W. Seavey (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 15p.

A description is given of a method by which an unknown voltage may be examined during a very small increment of time. Two methods of sampling the signal are described, with test results. (auth)

20855 (TID-12614) AN ULTRASENSTITIVE MICROCALORIMETER AND THE HEATS OF FORMATION OF U^{+4}(aq) AND UOH^{+3}(aq) (thesis). Edward E. Mercer (Purdue Univ., Lafayette, Ind.). July 1960. Includes Paper: AN ULTRASENSITIVE THERMISTOR MICROCALORIMETER AND THE HEATS OF SOLUTION OF NEPTUNIUM, URANIUM AND URANIUM TETRACHLORIDE. G. R. Argue, E. E. Mercer, and J. W. Cobble. Contract AT(11-1)-347. 11p.

A sensitive solution microcalorimeter using a thermistor-amplifier bridge and automatic recording was constructed and evaluated. The sensitivity is 1×10^{-5}°C; with magnesium, heats of solution in 1 M HCl were measured to ±0.2% for samples of 19.51 μg. The device was designed for use in determining thermodynamic functions of actinide elements and compounds. Heats of formation of U(IV) in 1 M HCl, U^{4+} (aq), UCl_4 (C) were redetermined and new values are reported for Np(IV), Np(III) in 1 M HCl, and Np^{4+} (aq), Np^{3+} (aq). (auth)

20856 (TID-12856) SEMICONDUCTOR DETECTOR SYSTEMS (dE/dx AND E) FOR THE DETECTION AND MASS IDENTIFICATION OF PROTONS, DEUTERONS, TRITONS, He^3 AND ALPHA PARTICLES IN THE 10- TO 30-MEV ENERGY REGION. H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). [1961]. 37p.

The use of semiconductor detectors for investigation of particles in the region from 10 to 30 Mev is discussed. In this energy region, simple single-counter detecting systems cannot be employed except in special cases because of the many competing reactions which may obscure the reaction of interest. One method of separating the various particle groups so that they may be observed independently is through the use of a dE/dx detector in conjunction with a total energy or E detector. A system using a gas ion chamber dE/dx counter and a semiconductor E counter is described. A comparison of the C^{11} spectrum observed with a semiconductor system and a NaI system and the mass identification of a mixed beam of He^3 and He^4 particles are shown. A thin semiconductor dE/dx detector is described. The semiconductor dE/dx detector when used with a semiconductor E detector separated He^3 and He^4 particles in a manner similar to the gas ion chamber-semiconductor dE/dx and E system. The mass separation was improved. Criteria for optimum energy resolution with dE/dx and E detector systems are presented. The use of coherent addition to improve the effective separation of a detector is discussed. (M.C.G.)

20857 (TID-12891) INSTRUMENTS AND ANALYSIS. A. C. Titus (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. 5p.

For presentation at the Conference on Analytical Chemistry, General Electric Co. Research Lab., Schenectady, N. Y., June 6, 1961.

Some instruments used in chemical and physical analyses are described. They include a deflection mass spectrometer for use on gas samples, systems for surface area determination with an inert gas, a sorptometer, x-ray fluorescence spectrograph, an LECO analyzer utilizing the platinum flux method of fusion in argon for oxygen determination in zirconium and Zircaloy-2, pycnometers, electron microscopes, and instant mercury vapor detector. (M.C.G.)

20858 (UCRL-9469) RESISTANCE MEASUREMENTS TO 400 KILOBARS. Juozas R. Vaisnys, Harold Stromberg, and George Jura (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Nov. 8, 1960. Contract W-7405-eng-48. 12p.

A modification of the Bridgman anvils is described which permits studies to be made to a load of 400 kbars. The external deformation of the anvils was studied for 0.25-in. faces of 1-in. diam. carbides. Experimental data show that AgCl is an insulator to the highest loads (>400 kbars) and that Se is a semiconductor to a load of 270 kbars. (D.L.C.)

20859 (NP-tr-631) ENERGY INDEPENDENT DOSIMETER FILMS. K. Becker (Gesellschaft zur Förderung der Kernphysikalischen Forschung, Jülich, Germany). Translated by J. S. Mills (U.K.A.E.A., Atomic Energy Research Establishment). [1960]. 58p.

Methods for increasing the sensitivity of film dosimetry techniques are discussed. A photographic film is described which has an emulsion containing, besides the silver halide, a qualitatively and quantitatively controlled addition of organic phosphor, permitting the use of film scintillator combinations as ordinary badge films. It can be developed by conventional wet methods. Primary and secondary blackening are discussed. The mixture ratio of AgBr to terphenyl leading to energy independence was determined empirically for different types of emulsions. It was found that appreciable quantities of organic fluorescent material can be added even to high-sensitivity photographic emulsions without disadvantageous influence on it in mechanical or photographic respects and that the fluorescent light utilization is appreciably increased by these additives. (M.C.G.)

20860 ILLUMINATION OF BUBBLE CHAMBER. D. V. Neagu (Joint Inst. for Nuclear Research, Dubna, USSR). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 999-1022(1960). (In Rumanian)

The track of an ionizing particle registered by a bubble chamber represents a range of bubbles from 0.2 to 0.4 mm in diameter. Photographing should be ended 2 to 3 msec after the passage of the particle. The selection of illumination and photography systems is limited by the peculiarities of the photographic objective and by the necessity of obtaining a sufficient precision. Some methods of illumination and photography in the bubble chamber are analyzed. The lensed selective reflector and the stratified selective reflector are especially considered. (tr-auth)

20861 CONDENSER CHAMBER DOSEMETER FOR RADIATION MEASUREMENT AT LOW DOSE RATE. R. Thoreaus (Karolinska Sjukhuset, Stockholm). Acta Radiol., 55: 315-20(Apr. 1961). (In English)

A cylindric condenser chamber dosemeter for exposure dose measurement of low-dose-rate radiations and its calibration results are described. As the chamber has a very low energy dependence it can be used with the same average calibration factor for radiations of energies from 40 kv and practically up to the present upper limit of the official validity range of the international roentgen unit. (auth)

20862 FILTER PHOTOMETRY USING CADMIUM SULFIDE DETECTORS. G. A. Rost (Dow Chemical Co., Rocky Flats Plant, Denver). Anal. Chem., 33: 736-8(May 1961).

A filter photometer, using a cadmium sulfide photoconductive cell as the light sensing device, is designed for remote monitoring applications such as are encountered in glove box operations. It is a simple beam instrument and is used primarily for ion column solution analysis. At normal room temperatures the stability of the photometer is ±2% for a 24-hour period. The temperature coefficient is −0.8% per °C from 0 to 50°C. It does not provide temperature compensation since all units are operated at room temperature with only small daily fluctuations. It is not intended to have the stability of chopper stabilized units. It is built for ruggedness, low cost, simplicity, and easy maintenance. The useful life is in excess of six months under continuous operation in a corrosive atmosphere. (N.W.R.)

20863 A LIQUID SCINTILLATION COINCIDENCE COUNTER FOR RADIOCARBON. K. J. Nygaard (Norges Tekniske Høgskole, Trondheim, Norway). Appl. Sci. Research, B, 9: 89-92(1961). (In English)

Measurements are made of the radiocarbon counting performance of a liquid scintillation coincidence counter used in conjunction with an anticoincidence shield counter. When operated at room temperature, the system has a radiocarbon counting efficiency of 59% at a background of 16 counts/min. The activity of ethanol made from contemporary wood is determined to 13.1 ± 0.6 disintegrations per minute per gram carbon. (auth)

20864 A SIMPLE LOW BACKGROUND PHOTON COINCIDENCE DETECTOR FOR TRITIUM LIQUID SCINTILLATION COUNTING. R. S. Sigmond and K. G. Schjetne (Norges Tekniske Høgskole, Trondheim, Norway). Appl. Sci. Research, B, 9: 93-101(1961). (In English)

The electronic system consists of two 13-stage Venetian blind photomultipliers coupled to a simple DeBenedetti-Richings coincidence circuit, followed by a medium-gain amplifier, pulse selector, and scaler. The main feature of the system is its simplicity, chiefly realized by utilizing the quasi-linear transfer properties of the take-the-lesser type coincidence circuit. Balance-point operation permits the use of multiplier high voltage supplies and pulse amplifiers not possessing the high stability usually required for scintillation counting. The counter is operated at 26°C with a tritium counting efficiency of 16% at a background of 100 cpm. The minimum detectable tritium concentration in water is 1.7×10^{-8} c/liter. However, the time needed for the counter to "quiet down" after a change of sample is prohibitively long, 2 to 3 days. Of the background, nearly 50% seems to be caused by light interaction between the photomultipliers. Some suggestions for future improvements are given. (auth)

20865 AN ANALYSIS OF THE BACKGROUND RADIATION IN THE ENERGY REGION 0.08−1.7 MeV AS DETECTED BY A SCINTILLATION COUNTER. J. Baarli and K. Madshus (Norwegian Radium Hospital, Oslo). Atompraxis, 7: 167-70(May 1961). (In English)

A study of background radiation with a heavily shielded scintillation counter design to be used for low-level γ spectroscopy is described. The counter consists of a $2\frac{1}{2}$ in. × 3 in. NaI(Tl) crystal together with iron and lead shielding. The background counting rate is reduced by 29% in the energy range 0.08 to 1.7 Mev when the interior is lined with 3 mm lead of low specific activity. Studies are also presented on the long time stability of the pulse height recording system and of the total counting rate observed by the detector. (auth)

20866 THE COUNTING CHARACTERISTICS OF A METHANE FLOW COUNTER AND THEIR DEPENDENCE ON THE SHAPE OF THE LOOP. H. Münzel and M. Hollstein (Institut für Radiochemie, Kernforschungzentrum, Karlsruhe, Ger.). Atompraxis, 7: 176-8(May 1961). (In German)

The counting characteristics of a methane flow counter were determined for a number of different loops. The measurements show that it is possible with a suitable loop shape to reduce the background by a factor of 2 with only a small decrease in counting efficiency. (auth)

20867 THE INFLUENCE OF VARIOUS MATERIAL CONDITIONS ON MEASUREMENT YIELD IN LIQUID SCINTILLATION SPECTROSCOPY. H. W. Scharpenseel (Universität, Bonn). Atompraxis, 7: 178-81(May 1961). (In German)

C^{14} and H^3 were tested in regard to their influence on measurement yield. A comparison of glass, quartz, and polyethylene measurement bottles showed that in the wavelength range of the scintillations, polyethylene has the most favorable translucency properties. The marked influence of solution purity and oxygen purity in liquid samples was tested, as well as the use of plexiglass light tubes in measuring weak β rays. Here cross-section reflectors of TiO_2 and colloidally dispersed silver provide particularly high measurement yields. In flow measurements with plastic scintillator spirals or in direct measurement of active aqueous solutions using the Steinberg method in plastic scintillator beads, the use of light tubes considerably increased the measurement yields. (auth)

20868 A TWO-BEAM PHOTOELECTRIC ELECTRON-BEAM TUBE SPECTROPHOTOMETER. M. M. Gurevich and K. I. Kolyadin. Byull. Izobretenii, No. 11, 47(1960).

A two-beam photoelectric electron-beam tube spectrophotometer is described. It has the following special features: the stability of the bundle of rays coming out from the monochromator's slit is maintained, and the regulation of the wave length of this bundle is performed by a moving inlet slit constituting a through-cut in the side of a revolving obturator. A prism vibrating at a frequency twice as low as the frequency of the passage of spectra and placed after the monochromator, switches the spectra over to two channels. A variant of this model is distinguished

by the following special features: the photo-current is compensated within the instrument's spectral range by an irregularly-shaped diaphragm located beyond the inlet slit and having the form of a window of varying width. Another variant is distinguished by the following features: for obtaining on the screen a zero passage line by sweeping the beam of the electron-beam tube during the intervals between the spectra, the sweep generator has a frequency two times higher than the frequency of the passage of spectra. This spectrophotometer is equipped with an additional illuminator, which lights up samples so as to make it possible to watch the variations of light-absorption in the sample being examined. (auth)

20869 AN IONIZATION CHAMBER. A. V. Klimushev. Byull. Izobretenii, No. 15, 59(1960).

The ionization chamber constitutes an ionization gas analyzer's pickup and consists of an operating and a compensatory compartment containing identical electrodes. To increase the gas analyzer's sensitivity, this chamber is fitted with a sylphon whose flanged edge serves as a screen for the compensatory α-emitter. (auth)

20870 DETECTION AND MEASUREMENT OF RADIATIONS IN NUCLEAR PLANTS. Luciano Sani (Università, Rome). Elettrotecnica, 47: 738-54(Nov. 10, 1960). (In Italian)

The first part of a review of the state of the art in radiation detection instruments is presented. The fundamentals of operation of the various types of detectors are outlined, and the outline is then expanded to a fuller discussion of the characteristics and designs of detectors. (T.R.H.)

20871 THE FOCUSING OF BETA PARTICLES IN A SHORT-LENS SPECTROMETER. R. Nathe (Amt für Kernforschung und Kerntechnik der DDR, Berlin), J. Schintlmeister, H. Seidenfaden, and R. Weibrecht. Exptl. Tech. Physik, 9: No. 1, 1-12(1961). (In German)

Investigations made to determine the focusing properties of a short-lens beta spectrometer are described. In analogy to the spherical lens in optics, a spherical aberration also occurs in a magnetic lens which affects the focusing properties of the lens spectrometer. For the improvement of focusing and therefore the resolution, there are two practical possibilities: introduction of ring focus screens and decrease of the spherical aberration by correction coils. Both methods were experimentally investigated. It was shown that with both ring focus and correction coils about the same improvement is obtained. (tr-auth)

20872 A SENSITIVE POCKET DOSIMETER READER. H. V. Larson (General Electric Co., Richland, Wash.). Health Phys., 4: 233-5(1961).

A modified Townsend balance circuit was used to measure the discharge of pocket ionization chambers. The reader consists of a vibrating reed electrometer, a recorder, and a stable voltage supply. This system has good sensitivity and excellent linearity. Also, because of negative feedback, the reader is nearly independent of the capacity of ion chambers that have the same volumes and that are made of the same materials. The discharge of a chamber with a volume of 5 cm^3 exposed to 1 mr of radiation can be reproduced to ±1.5%. (auth)

20873 SILVER METAPHOSPHATE GLASS FOR X-RAY MEASUREMENTS IN COEXISTENT NEUTRON AND γ-RADIATION FIELDS. C. H. Bernard, W. T. Thornton, and J. A. Auxier (Oak Ridge National Lab., Tenn.). Health Phys., 4: 236-43(1961).

Small glass rods, 1 mm in diameter by 6 mm long, composed of the metaphosphates of Al, Ba, K, and Ag, were exposed to both neutrons and γ radiation to determine their suitability as γ dosimeters in mixed fields. Filters in the form of cylindrical capsules were constructed to eliminate the major portion of the increased response per unit of exposure dose in the photoelectric region. The fast neutron response was determined in the energy range of 0.5 to 1.5 Mev; the maximum response in this range of energies was 0.7% of that of Co^{60} γ radiation in units of tissue rad. Thermal neutron exposures were made in the ORNL graphite reactor thermal column; flux measurements were made with Au and Au + Cd foils. A response equivalent to an exposure dose of 1 r of Co^{60} γ rays was induced by $(2.96 \pm 0.38) \times 10^9$ n_t/cm^2. Preliminary measurements with similar rods in which the elements Ba and K had been replaced by Mg and Li, respectively, indicate a lower peak γ response per unit of exposure dose in the photoelectric region and an increased sensitivity to thermal neutrons; 1 r equivalent response was produced by $(3.7 \pm 0.4) \times 10^8$ n_t/cm^2. (auth)

20874 THE VIBRATING-REED ELECTROMETER AS A LOW-LEVEL α-DETECTOR. F. J. Bradley (Ohio State Univ., Columbus). Health Phys., 4: 298-301(1961).

Design features are described of a low-level α counter which employs a vibrating reed electrometer as the detecting element. A sketch of the α chamber and a photograph of the complete chamber and electronic set-up are included. Results are presented from measurements of the pulse-height distribution of α particles from Sm^{147}. (C.H.)

20875 AN INTEGRATING ION CHAMBER DOSEMETER. B. M. Wheatley (European Organisation for Nuclear Research, Geneva). Health Phys., 4: 301-2(1961).

Design features are described for an integrating ion chamber dose meter developed for radiation survey work on the Cosmotron. The complete instrument consists of a Rossi tissue equivalent chamber connected to a vibrating-reed electrometer with accessory circuits. For use as an integrating instrument one of the high value resistors normally fitted in the head unit is removed so that the current from the ionization chamber charges the input capacity due to the chamber itself and its connections. The accessory circuit is a transistorized Schmitt trigger which operates when the voltage developed across the input capacity corresponds to the full scale value on any range of the main unit. A sketch of the circuit and a photograph of the complete instrument are included. (C.H.)

20876 SIMPLIFIED AUTORADIOGRAPHY TECHNIQUE FOR α-EMITTERS. E. L. Geiger, A. N. Tschaeche, and E. L. Whittaker (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev.). Health Phys., 4: 302-4(1961).

A simplified technique is described for the preparation of radioautograms from tissues and excreta containing Pu^{239}. The technique can also be used for the determination of extremely low levels of any α emitter that can be electroplated along with Ni^{63}. (C.H.)

20877 A GEIGER-MUELLER γ-RAY DOSIMETER WITH LOW NEUTRON SENSITIVITY. E. B. Wagner and G. S. Hurst (Oak Ridge National Lab., Tenn.). Health Phys., 5: 20-6(1961).

It is shown that a commercially available halogen type Geiger–Mueller counter, when properly shielded with Sn and Pb, provides a very practical and satisfactory device for measuring the dose due to γ radiation in the presence of neutrons. The device measures the dose in roentgens

with nearly uniform response for effective x-ray energies above about 200 kev and up to at least 1.25 Mev γ energies. Calculations show that the fast neutron response is less than 0.15%, and experiments indicate that it is less than 0.5%. Experiments show that about 5×10^9 thermal neutrons per cm^2 give a response equivalent to 1 r of γ radiation. When necessary, the thermal neutron response can be decreased by a factor of 300 by using a Li shield. (auth)

20878 LARGE PLASTIC SCINTILLATORS FOR RADIOACTIVITY MEASUREMENT. G. L. Brownell (Massachusetts General Hospital, Boston), W. H. Ellett, R. A. Rydin, and G. J. Hine. Health Phys., 5: 27-36(1961).

This study of counting systems utilizing large plastic scintillators includes an investigation of the component parts, the γ spectra obtained from large scintillators, and the application of large scintillators to total-body and low-level sample counting. Properties of the component parts investigated included light production from plastic scintillators of different manufacture, the influence of crystal size and shape on light collection efficiency, and the photocathode response of 5-in. and 16-in. photomultiplier tubes. Experimental spectra taken with a 16-in. diameter by 8-in. thick cylinder of plastic are shown and the results for 0.662 Mev γ rays compared to a calculated pulse-height distribution. The application of large plastic scintillators to total-body counting is evaluated by comparing the response of an array of 16-in. by 8-in. plastic scintillators to a single 8-in. by 4-in. NaI detector. Spectra taken with an 18-in. by 18-in. plastic well counter are presented, and data are presented on the performance of this device as a low-level sample counter. (auth)

20879 LOCAL QUANTUM EFFICIENCY IN COUNTER TUBES. I. CALCULATIONS. Tatsusaburo Suzuki (Technical Research and Development H. Q., Japan Defense Agency). J. At. Energy Soc. Japan, 3: 266-75(Apr. 1961). (In English)

Local quantum efficiencies in Geiger counter tubes made of Fe and glass are computed. This computation is made by assuming that multiple scattering or diffusion takes place for secondary electrons produced in the counter wall. It is found that the computed local quantum efficiency greatly depends upon the angle between the incident direction of gamma rays and the inner surface of the counter or inner diameter of the counter. (auth)

20880 SOME ASPECTS OF IONIZING PARTICLE TRACKS IN SLIGHTLY SENSITIVE PHOTOGRAPHIC EMULSIONS. Marie Ader (Collège de France, Paris). J. phys. radium, 22: 61-2(Jan. 1961). (In French)

Protons and particles with an abnormally long path from Po were registered in Ilford emulsions at an almost flat incidence. A close examination of the emulsions showed that low energy particle tracks are formed of rectilinear dense segments separated by very small gaps. In 70% of the cases a change of direction of the track is preceded by an apparent gap. In the tracks of particles with the highest energy a gap marks a change of grain density as if the capture phenomenon followed by release causes a real variation of the particle energy and perhaps the emission of another particle not registered in the emulsion. (J.S.R.)

20881 SOME ASPECTS OF IONIZING PARTICLE TRACKS IN SLIGHTLY SENSITIVE NUCLEAR EMULSIONS. [PART] II. Marie Ader. J. phys. radium, 22: 123-6(Feb. 1961). (In French)

Alpha particle tracks from ThC″ recorded at an almost flat incidence in Ilford K-1 and K-2 emulsions were studied. The tracks are not rectilinear points but obey deviations. These deviations are not localized only at the extremity of the track. The same track can show several changes of direction. On the negatives, a succession of variation of grain density and of gaps appear to indicate that in the crossing of a dense material an α particle undergoes successive charge changes: He^{2+}, He^{+}, and HeO, after capture and electron loss. (J.S.R.)

20882 PARASITE SCATTERING AND TREATMENT OF NUCLEAR EMULSIONS. Jacques Bermond, Claudette Patou, and Maurice Scherer (Faculté des Sciences, Caen). J. phys. radium, 22: Suppl. to No. 2, 30A-4A(Feb. 1961). (In French)

A study was made of the influence on parasitic scattering of different parameters in emulsion treatment, in particular soaking in glycerine, drying, and development temperature. (tr-auth)

20883 FAST COINCIDENCE CIRCUITS USING AVALANCHE TRANSISTORS. J. C. Artiges and J. C. Brun (Laboratoire de Physique Nucléaire, Service d'Électronique Physique, Orsay, France). J. phys. radium, 22: Suppl. to No. 2, 53A-8A(Feb. 1961). (In French)

The use of ordinary transistors working with delayed collector conduction (avalanche) in fast trigger circuits (rise time 10^{-8} sec) is investigated. Fast coincidence circuits built with this element are described. This circuit is studied with a pulse generator and with phototube signals. The results coincide with those obtained by a whole series of experiments. A resolution time of 2×10^{-9} sec with 90% efficiency was obtained. (tr-auth)

20884 CONSTRUCTION AND TESTS OF A COMPRESSED GAS CHERENKOV COUNTER. STUDY OF THE POLLUTION OF A BEAM. J. Duboc (College de France, Paris), J. Banaigs, and J. F. Detoeuf. J. phys. radium, 22: Suppl. to No. 2, 64A-7A(Feb. 1961). (In French)

The construction of a compressed-gas Cherenkov counter permitted the study of the pollution of a beam of π mesons with momentum varying from 220 to 1,100 Mev/c. (auth)

20885 THE DOUBLE-GRID IONIZATION CHAMBER. Iwao Ogawa and Tadayoshi Doke (Rikkyo (St. Paul's) Univ., Tokyo). J. Phys. Soc. Japan, 16: 1025(May 1961).

A double-grid ionization chamber is designed such that the additional grid serves as a screen grid and eliminates a serious loss in the energy resolution. The energy spectrum of the alpha particles from a natural uranium source obtained with this chamber is shown. The grid pulse-height distributions due to U^{234} and U^{238} are graphically shown, and the separation of the grid pulses is satisfactory in spite of the rather small difference in energy of the alpha particles. (N.W.R.)

20886 ADULTERATION OF THE PULSE-HEIGHT SPECTRUM IN THE SINGLE CHANNEL SPECTROMETER. K.-H. Berger. Kernenergie, 4: 181-92(Mar. 1961). (In German)

The effect of the channel width, load-time constants, the integration time constants, and the scanning velocity on the shape of a photopeak was investigated on the Gaussian distribution curve $y = e^{-x^2}$. For the variation of the maximum counting rate and the resolution, suitable approximation formulas were obtained for the practical range. The interaction of this adulteration with the statistical error was investigated in dependence on the channel width and the effect of the amplication. For the shortest possible scanning time, a rough formula was given. Measurements gave value which deviated by a maximum of 7% from the calculated values. (tr-auth)

20887 SIMULTANEOUS MEASUREMENT OF FIELD STRENGTH AND GRADIENT OF A PERIODICALLY CHANGING MAGNETIC FIELD. Malavalli N. Viswesvariah (Inst. of Nuclear Physics, Calcutta). Kernenergie, 4: 193-205 (Mar. 1961). (In German)

Simultaneous measurements were made of the field strength and gradients of a periodically changing magnet field. Both magnitudes were registered separately. The method can be used for the direct calculation of the field index n which is very important for the betatron and synchrotron magnets. (tr-auth)

20888 MEASUREMENT OF X-RAY DOSES BY CADMIUM CRYSTAL. T. Tanaka and H. Isobe (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 565-71(1959).

Dosage measurements by cadmium crystals were performed and the following results were obtained. The dependency of cadmium crystals on x-ray wave-length was much less than that of the usual dosimeter. The cadmium crystal produced photoelectric current by x- and β-irradiation that can be used as a dosimeter without amplifier. (auth)

20889 THE USE OF A COUNTER CONTROLLED HIGH PRESSURE CLOUD CHAMBER FOR EXPERIMENTS WITH CHARGED PARTICLES. D. J. Cairns, T. C. Griffith, G. J. Lush, A. J. Metheringham, and R. H. Thomas (University Coll., London). Nuclear Instr. & Methods, 10: 272-80(Apr. 1961). (In English)

An account is given of an expansion cloud chamber operated at pressures up to 70 atm with a beam of protons from the Harwell synchrocyclotron. The usefulness of the cloud chamber for experiments with charged particles is enhanced by the control system of scintillation counters employed to trigger the expansion only when specific interactions occur in the gas. This arrangement allows events to be photographed at the rate of 30 per hour. (auth)

20890 PARASITIC REFLECTIONS OF NEUTRONS IN CRYSTAL MONOCHROMATORS. K. Blinowski and J. Sosnowski (Inst. for Nuclear Research, Warsaw). Nuclear Instr. & Methods, 10: 289-94(Apr. 1961). (In English)

The intensity of a monoenergetic neutron beam obtained by reflection from a crystal monochromator is very often decreased due to the additional so-called parasitic scattering. Since this effect gives several percent fluctuations of the intensity, it must be taken into account in precise measurements. In particular, it is important in neutron spectrum studies by Bragg reflection. For a given reflecting plane two parameters are responsible for multiple scattering: Bragg angle and spatial orientation of the monochromator. Suitable choice of the second parameter permits the elimination of parasitic reflection. The Cu monochromator is rotated about an axis perpendicular to the (111) reflecting plane. The intensity of reflected thermal neutrons is measured versus angle of rotation. Results showing the influence of multiple reflections are found to agree with calculated angular positions for chosen Bragg angles. (auth)

20891 A MAGNETIC COMPTON SPECTROMETER FOR INVESTIGATING HIGH-ENERGY BREMSSTRAHLUNG SPECTRA. K. Felbinger, H. Kulenkampff, M. Scheer, and E. Schrüfer (Universität, Würzburg, Ger.). Nuclear Instr. & Methods, 10: 295-300(Apr. 1961). (In German)

Construction and operation of a magnetic Compton spectrometer are described. The analysis of data measured with this spectrometer in order to obtain the Bremsstrahlung spectrum is illustrated. As an example the intensity distribution of the Würzburg 30 Mev Betatron is determined as a special case. (auth)

20892 A THEORY OF MAGNETIC COMPTON SPECTROMETERS. E. Keil and E. Zeitler (Universität, Würzburg, Ger.). Nuclear Instr. & Methods, 10: 301-7 (Apr. 1961). (In German)

A theory is formulated to calculate the luminosity and resolution of Compton spectrometers in the energy range from 10 to 30 Mev. The formulas are evaluated approximately. The influence of quantum energy and geometry of the Compton spectrometer on luminosity and resolution is discussed. Scattering of Compton electrons is regarded. (auth)

20893 A FAST TRANSISTORIZED DISCRIMINATOR. H. Verweij (CERN, Geneva). Nuclear Instr. & Methods, 10: 308-14(Apr. 1961). (In English)

A fast transistorized discriminator is described. The threshold can be varied from 100 mv to 2.1 v. Stable operation is obtained for rates up to at least 10 Mc. The unit gives a negative output pulse of 2.5 to 3 v and a positive of 9 v, both into 125 ohm. (auth)

20894 USE OF CATHODE RAY TUBES IN PULSE-HEIGHT SPECTROSCOPY. P. Thieberger and I. Bergström (Royal Inst. of Tech., Stockholm). Nuclear Instr. & Methods, 10: 315-21(Apr. 1961). (In English)

The possibility of using the cathode ray oscilloscope (C.R.T.) for single channel pulse height analysis in gamma ray measurements is studied. Two ways of generating signals obtained when the beam of a C.R.T. hits a certain part of its screen are used for manual (one oscilloscope used) and automatic (two oscilloscopes used) analysis of pulse spectra from NaI-crystal detectors. The signals are obtained either by viewing the screen of a conventional C.R.T. by means of a photomultiplier tube or by making use of a specially designed C.R.T. provided with additional internal electrodes from which pulses are directly derived. It is concluded that the equipment is suited for energy and intensity comparisons of gamma rays. It is shown that the energy linearity is good and that it is possible to record photo peaks corresponding to gamma-energies as low as about 5 kev. Compared to conventional setups this arrangement shows several advantages and no additional limitations are found. (auth)

20895 IMPROVED AUTOMATIC OPERATION OF A DOUBLE FOCUSING IRON-YOKE β-SPECTROMETER. E. Arbman and B. Jung (Univ. of Uppsala). Nuclear Instr. & Methods, 10: 322-6(Apr. 1961). (In English)

The construction and performance of an arrangement for the automatic operation of a double focusing β-spectrometer are described. Digital recording of the number of counts for a preset time and accurate advancement of the spectrometer current in 750 steps preserve high accuracy. The preset time is variable between 1 and 1090 seconds and the 750 steps can be spread over almost any part of the total momentum range of the spectrometer. (auth)

20896 CHARGED PARTICLE DISCRIMINATION IN A CsI(Tl) DETECTOR. J. A. Biggerstaff, R. L. Becker, and M. T. McEllistrem (Univ. of Kentucky, Lexington). Nuclear Instr. & Methods, 10: 327-32(Apr. 1961). (In English)

Two techniques requiring measurement of short time intervals are reported. A charged reaction product discrimination method is developed that depends upon the fact that different types of charged particles of approximately the same energy yield significantly different fluorescent

decay times in a CsI(Tl) scintillator. Tests are conducted on the reaction products of the Be^9 + d reactions and on the protons from the $C^{12}(d,p)C^{13}$ reaction. Using relative decay time measurements, alpha particles are clearly separated from protons or tritons. Protons and tritons are clearly separated from one another as long as the triton energy does not exceed the proton energy by as much as twenty percent. (auth)

20897 A COUNTER TELESCOPE SYSTEM FOR FAST NEUTRON STUDIES. R. N. Glover, K. H. Purser, and E. Weigold (Australian National Univ., Canberra). Nuclear Instr. & Methods, 10: 343-7(Apr. 1961). (In English)

The design of a counter telescope to measure angular distributions in the range 0 to 150° for neutron induced reactions is outlined. The operation and performance of the equipment, which includes, in addition to the usual circuitry, fast coincidence equipment based on the detection of the associated α particle from the $d(t,n)\alpha$ reaction and equipment to identify charged particles of different mass are described. (auth)

20898 RECENT PROGRESS IN SCINTILLATION COUNTERS. Y. Koechlin (Centre d'Etudes Nucleaires de Saclay France). Onde élec., 396, 8p. (Mar. 1960). (CEA-1571). (In French)

A bibliographic review of the progress made in the field of scintillation counters is presented. The possibilities for these counters and the measuring apparatus using them are discussed. Details of the performance of some scintillation counter assemblies are discussed and described starting from counters whose principal constituents, scintillators and photomultipliers, are manufactured by French industry. (N.W.R.)

20899 TERRESTRIAL-FIELD MAGNETOMETER USING NUCLEAR PARAMAGNETIC RESONANCE WITH DYNAMIC POLARISATION OF THE NUCLEI. I. THEORETICAL BASIS. J. Freycenon and I. Solomon (Centre d'Etudes Nucléaires, Saclay, France). II. DESIGN AND CONSTRUCTION. J. Freycenon (Centre d'Etudes Nucléaires, Saclay, France). Onde élec., 40: 590-601(Sept. 1960). (In French) (CEA-1905)

A brief survey of nuclear magnetic resonance principles is presented. Dynamic polarization is defined. Some results of the operating theories of a nuclear auto-oscillator were used to determine the main characteristics of an earth-magnetic-field meter. Conditions for auto-oscillation, the auto-osicllation range, frequency pulling, and precision were determined. The design and construction of a terrestrial-field magnetometer using these principles are described. (auth)

20900 TEMPERATURE SETTING AND THERMAL REGULATION SYSTEM FOR LIQUID HYDROGEN BUBBLE CHAMBER. J. Meyer, P. Prugne, and P. Roubeau (C. E. N., Saclay, France). Proc. Intern. Congr., Copenhagen, 1959, 1: 203-6. (In French)

A variable impedance heat exchanger is designed, built, and operated in a liquid hydrogen bubble chamber for cooling and regulating the temperature in the 25 to 28°K range. It automatically allows the introduction of a variable amount of cold to counterbalance the heat transfer either static or due to the chamber operation. The device, which takes little space (less than 1000 cc) allows transfer of a variable cold power between 0 and 500 watts (0 to 50 liter of evaporated hydrogen). (N.W.R.)

20901 METHOD OF MAKING SMALL POINTED THERMOCOUPLES. Clifford M. Stover (Sandia Corp., Albuquerque, N. Mex.). Rev. Sci. Instr., 32: 366-8(Mar. 1961). (SCR-170).

A method for making small diameter single-ended tip thermocouples for measuring rapid temperature changes is described. The procedure consists of working down a straight piece of 0.032-in. Constantan wire to 0.005-in. or less, tapering in a pin vise, knurling the butt end, oxidizing at high temperature, adding a copper sleeve at the butt end with Sauerisen #29 cement, coating the tip with a thin glaze ceramic paint, heating the glaze for fusion, removing copper oxide from the sleeve, adding and curing Midland 11 × 712 cement to all but the tip, coating the assembly with copper by evaporation, removing the copper from the tip with nippers, and finally electroplating the assembly with copper. (N.W.R.)

20902 IMPROVING THE DYNAMIC BEHAVIOR OF ION-CHAMBER CURRENT AMPLIFIERS. C. E. Cohn (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 23(June 1961).

20903 ORGANO-SILICON COMPOUNDS FOR RADIATION DETECTION. C. G. Weis, A. F. Vetter, G. John, and L. Spialter (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Trans. Am. Nuclear Soc., 4: No. 1, 23-4(June 1961).

20904 FATIGUE IN PHOTOMULTIPLIER TUBES AND ITS RELATIONSHIP TO THE MALTER EFFECT. I. Cantarell and I. Almodovar (Puerto Rico Nuclear Center, Mayaguez). Trans. Am. Nuclear Soc., 4: No. 1, 24-5(June 1961).

20905 A USEFUL DEVICE FOR LOCATING THE INTERFACE IN A BUBBLING TWO-PHASE MIXTURE. J. E. Wilson and R. E. Potthoff (Allis-Chalmers Mfg. Co., Milwaukee). Trans. Am. Nuclear Soc., 4: No. 1, 25(June 1961).

20906 BETA-GAMMA DELAYED COINCIDENCE METHOD FOR U-238 ACTIVATION ANALYSIS. L. S. Beller (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 28-9(June 1961).

20907 CALIBRATION OF A SLIT COLLIMATED SCINTILLATION COUNTER. J. P. Concannon, R. E. Summers, Jr., N. S. Williams, and C. V. Mooers (Allegheny General Hospital, Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 130(June 1961).

20908 UNIT FOR AUTOMATIC COMPUTING AND PLOTTING THE TRAJECTORIES OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS WHEN A SPACE CHARGE EXISTS. I. M. Bleyvas. Trudy Konf. Elektronike Sistemy Vysokoi Chastoty, 133-49(1957).

The description is given of an automatic device for computing and plotting the trajectories of charged particles in electric and magnetic fields in modern SHF-electrovacuum devices. The particle trajectories are computed in the Cartesian coordinate system under consideration of the effect of the space charge and the relativistic correction. The electric field was simulated by an electrolytic tank. The computer of the unit is based on the application of d-c electronic integrators in combination with non-linear electronic units. The duration of plotting one trajectory amounts on the average to 2 to 3 minutes. The trajectories of particles are drawn with an error not exceeding 1 to 2% and the lines of force and equipotential lines with an error of 1%. (auth)

20909 RECORDING AND AMPLIFYING RECEIVER FOR SHORT-TIME SPECTROSCOPY. Richard Schneider

Fritz Maisenhälder, and Manfred Kling (Technische Hochschule, Stuttgart). Z. angew. Phys., 13: 211-15(Apr. 1961). (In German)

An apparatus is described which is able to detect spectra of very short illumination time and to amplify and record them. In a modified form this apparatus can be used also for the measurement of intensity profiles of stationary arcs. Applications are given. (tr-auth)

20910 TYPICAL BUBBLE CHAMBER DESCRIPTION WITH RELATIVISTIC ELECTRONS FOR ENERGIES UNDER 30 MEV. Gert Harigel (Universität, Würzburg, Ger.), Dierk Lüers, Hans-Michael Mayer, Max Scheer, and Klaus Schultze. Z. angew. Phys., 13: 217-23(May 1961). (In German)

A 10-cm bubble chamber which works with a 35-Mev betatron was described. The arrangement for the production of individual electrons and the synchronization with the betatron was explained. Bubble chamber exposures, which are characteristic for electrons up to 30 Mev, were shown. On the basis of these exposures experiments were indicated for which a bubble chamber would be preferable to other detection methods. (tr-auth)

20911 SENSITIVITY OF ILFORD Q_1 PLATES. E. Burlefinger and H. Ewald (Technische Hochschule, Munich). Z. Naturforsch., 16a: 430-1(Apr. 1961). (In German)

The sensitivity of Ilford Q_1 plates for ions of approximately 17.5 kev was investigated in dependence on mass. The experimental method is described. An evaluation of the results showed a proportionality between the ion and grain density for each ion mass. The absolute sensitivity for H_2^+ ions was measured at 0.31 ± 0.03. The dependence of the relative sensitivity on the mass number is tabulated for 13 singly charged ions. (J.S.R.)

20912 BEAM DIAGNOSTIC TECHNIQUES. L. R. Gallagher, F. Barcatta, M. P. Ernstene, A. T. Forrester, D. Marlow, R. C. Speiser, D. Telec, and R. S. H. Toms (Electro-Optical Systems, Inc., Pasadena, Calif.). p.447-56 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Measurements on an ion motor exhaust are extremely important for the evaluation of ion motor performance. This exhaust has certain unique properties for which special instrumentation had to be developed. Some of the important properties to be measured include the ion beam current, beam power, beam thrust, ion trajectories, potential distribution in the beam and charge distribution throughout the beam. The techniques whereby these measurements either were made or are being approached are discussed. (auth)

20913 INSTRUMENTATION PROGRAM FOR ION ENGINE TESTING. A. H. Weber, A. W. Thompson, and W. J. Robinson (George C. Marshall Space Flight Center, Huntsville, Ala.). p.555-75 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr. eds. New York, Academic Press, 1961.

Several of the considerations in preparing a flight test program for ion engines are discussed. Tables which illustrate the Scout performance, atmospheric particle density, and power sources and a simple schematic of the engine test package are included. The problem of beam diagnostics and the instrumentation required are also discussed. (auth)

20914 SBORNIK PRACI ELEKTROVAKUOVEHO OBORU. č. 1. (Symposium on Electronic Equipment. No. 1). Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. 287p.

Fifteen articles are presented. Topics discussed include magnetrons, negative-grid-quenching thyratrons, traveling wave tubes, phosphors and inorganic luminophors, kovar alloys, photoconductive tubes, transparent conductive coatings for betatron tubes, and cathodes. The subject of cathodes is discussed extensively. Oxide, carburized thoriated tungsten, and impregnated cathodes are studied; chemical analysis of Cu and Ni for purity are also examined. Separate abstracts are prepared for 7 of the 15 articles. All are in Czech. (T.F.H.)

20915 THE INFLUENCE OF REST GAS PRESSURE ON THE WORKING CHARACTERISTICS OF MAGNETRONS. Miroslav Lupínek and Václav Truksa. p.7-48 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

A theoretical analysis of the influence of rest gas pressure on the working characteristics of magnetrons is followed by a description of an improved technological method of magnetron production. (auth)

20916 A TRAVELLING WAVE TUBE OUTPUT AMPLIFIER FOR MICROWAVE RELAYS. T. Lom, M. Plecitý, J. Verzich, and Frant. Svoboda. p.49-81 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

On the basis of an energy balance between a traveling wave and an electron beam, the fundamental relations of traveling wave tube (TWT) theory are deduced. The results are given in the form of nomograms, which facilitate TWT design. Theoretical results are compared with experimental data measured for an output amplifier, designed for service in a microwave relay. (auth)

20917 THE TACITRON--A NEW USEFUL ELECTRON TUBE. Antonín Hix. p.82-114 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

A thyratron tube, the Tacitron, in which the discharge can be interrupted by a negative control grid bias voltage, is described. A discussion of the principles underlying the extinction of a discharge by grid action and a guide to the fundamentals of Tacitron construction are given. Using hydrogen as the filling gas results in a considerable increase in the controlled power. Experimental results underline the difference in electrical parameters attainable with various rare gas and hydrogen fillings, especially under pulsed conditions. Oscillograms of the rising and trailing edge of rectangular impulses are discussed in connection with their corresponding design parameters. Some practical applications and pertinent data of two hydrogen tacitrons are related. (auth)

20918 THE TECHNOLOGY OF IMPREGNATED CATHODES. Alois Vysloužil. p.188-205 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

The properties of impregnated cathodes are compared with "L" type dispenser cathodes. A description is given of the chemistry and function of the impregnated cathode. Special attention is paid to production methods. Topics of discussion include composition of the emitting material, preparation of the cathode body, methods of measuring porosity, pumping, and activation. Results of experimental investigations are given. (auth)

20919 A NOTE ON THE THERMIONIC EMISSION OF THORIATED TUNGSTEN. Peter Schneider. p.206-37 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

It is not possible to use uncarburated thoriated tungsten for the construction of thermionic cathodes in high power electron tubes because reduced elementary thorium quickly diffuses through tungsten, which leads to extensive Th evaporation from the surface and early loss of emitting power. For attaining the correct degree of carburation of the cathode, close control of the processing temperature, the concentration of benzene vapor, and the rate of flow of hydrogen is necessary. The desired surface layer is composed of W_2C; unsuitable processing leads to the formation of WC, which prevents the necessary diffusion of metallic thorium to the surface, or to the formation of elementary carbon, which reacts with thorium to form the non-emitting carbide ThC_2. The conditions for thermionic emission of electrons from thoriated tungsten are studied. (auth)

20920 COUNTER FOR LOW INTENSITY BETA RADIATION COMPENSATED FOR COSMIC RADIATION. P. Theodorsson (to Denmark Atomenergikommissionen). Belgian Patent 578,820. Priority date, May 20, 1958.

In order to eliminate the background noise due to cosmic rays and mesons, a totally shielded flat ionization chamber which beta rays cannot penetrate is placed against the measuring ionization chamber which can register beta rays through a window, as well as cosmic radiation and mesons. Anti-coincidence circuits eliminate the counts due to the latter radiations. Special flat geometry makes it possible to have only one compensating ionization chamber. (EURATOM)

20921 IONIZATION GAUGE FOR ALTITUDE OR DENSITY MEASUREMENTS. (to Bendix Corp.). British Patent 863,562. Mar. 22, 1961.

An altimetric device for measuring the density and/or pressure of a gas is described. It consists of an ionization gage having at least three coaxial cylindrical electrodes mounted in a sampling space for the gas, with alternate electrodes being electrically interconnected, a source of radioactive material in the space, and a circuit arrangement responsive to variations in ion current between the electrodes consequent to the variations in the density and/or pressure of the sampled gas. The device is readily adaptable for use in altimeters which may be energized by either alternating or direct current sources and which are highly accurate over a wide range of altitudes and at altitudes exceeding 400,000 feet. (N.W.R.)

20922 METHOD AND APPARATUS FOR MEASURING THE GAP BETWEEN A PAIR OF SPACED MEMBERS. John Samuel Griffiths (to Rolls-Royce Ltd.). British Patent 864,907. Apr. 12, 1961.

A measuring device and methods for using this device in the remote testing of the size of the gap between the fuel plates of a nuclear reactor are described. The device consists of an elongated probe which is rotatably mounted in or on a bearing member so that the probe may be rotated about its longitudinal axis, at least a portion of the probe having a flattened periphery such that when the flattened portion is introduced into the gap between a pair of spaced members there are two angular positions only of the probe in which the flattened portion will contact both the spaced members simultaneously. The micrometer head of the probe automatically records the gap size from the angle obtained. (N.W.R.)

20923 IMPROVEMENTS IN METHODS OF AND APPARATUS FOR MEASURING DENSITY OR MASS PER UNIT AREA. Norman Zinkan Alcock and Everett A. Carter (to Canadian Curtiss-Wright, Ltd.). British Patent 868,665. May 25, 1961.

A method and ionization chamber for measuring the density of a subject material by measuring the residual radiation passing through the material are described. The radiation energy apparatus consists of two ionization chambers each including an outer electrode and an inner electrode, and each being energized by a radiation source. A potential activates the outer electrodes at equal and opposite magnitudes above ground. There are means for electrically joining the inner electrodes to obtain combined d-c signal relative to ground zero responsive to equal energization of the detectors and of a magnitude and size responsive to the difference in energization of the detectors. One of the detectors has a free air gap between it and the radiation source and is adapted to accommodate a subject material to be examined. This detector contains a movable iris device adapted to control the energization of the other detector, means for driving the iris device responsive to the combined d-c signal, means providing an indicating signal responsive to the position of motion of the iris device, and biasing means for zero current flow. The apparatus also has indicating signal responsive circuitry and selectable switching means adapted selectively to communicate the indicating signal to the biasing means and to the indicating signal responsive circuitry. An ammeter contains scale markings adapted to indicate a correction factor for the indicating signal. (N.W.R.)

20924 IMPROVEMENTS IN OR RELATING TO RADIATION SENSITIVE INDICATING OR CONTROLLING DEVICES. Clifford Kenneth Beswick and Gordon William Whitehurst (to Simon-Carves, Ltd.). British Patent 868,696. May 25, 1961.

An indicating or controlling device made up of a radiation detector; comprising a radiation-sensitive device such as a Geiger-Mueller tube, an ionization chamber, or a scintillation counter for providing impulses according to the count of radiation falling from a radioactive source, is described. The detector also contains a transistor blocking oscillator type circuit adapted to be triggered by the impulses, an electromagnetic relay in the output of the oscillator adapted on energization from the current flow to energize an indicator or control circuit, and a resistance connected in series with the relay in such manner that upon the closing of the contacts of the relay, the resistance is by passed. The value of the resistance is 10% of the resistance of the coil of the relay. (N.W.R.)

20925 AUTOMATIC DEVICE FOR TAKING SAMPLES OF RADIOACTIVE SOLUTIONS. (to Commissariat a l'Energie Atomique). British Patent 869,249. May 31, 1961.

An automatic device for taking samples of radioactive solutions is described. The device consists of a sample bottle, a conduit feeding the bottle, means controllable by a single action to place the solution under vacuum, and an electro-pneumatic motor system consisting of a liquid switch which makes use of the contact between the radioactive solution and the feeding conduit. The vacuum means causes the solution to come into contact with the feeding conduit and to start to penetrate the feeding conduit. The system further comprises a vacuum valve and an atmospheric valve, the contact closing the vacuum valve opens the atmospheric valve which causes separation of the body of the solution from the fraction of the solution which has

enetrated the feeding conduit. Operation of the two valves s determined in such a way that the separation takes place t a given moment to collect the desired quantity of radio- ctive solution in the bottle. A security system which omes into operation if the device does not function prop- rly is also described along with the protective enclosure. N.W.R.)

20926 JACKETED NEUTRON-FLUX MEASURING AGE FOR NUCLEAR REACTORS. Karl Janner (to iemens-Schuckertwerke A. G.). Canadian Patent 612,001. an. 3, 1961.

A neutron flux sensing gage for measuring and continu- usly controlling the neutron flux of a reactor is described. The gage consists of a neutron flux detector and a compos- te jacket structure enclosing the detector and comprising nree layers, the innermost layer consists of a moderator ubstance of great diffusion length, the intermediate layer onsists of reflector substance of small diffusion length, nd the outermost layer consists of a neutron absorber. The neutron flux measuring gage is mounted on a gamma adiation absorber plate which in turn is mounted on the eactor vessel. There is a reflector mounted on the inner all of the vessel which forms a neutron permeable va- ancy behind the gamma absorber plate. (N.W.R.)

20927 BURST JACKET DETECTION IN NEUTRONIC REACTORS. Jean Goupil, Jean Mégy, and André Roguin (to Commissariat à l'Energie Atomique). Canadian Patent 614,220. Feb. 7, 1961.

A method and a device enabling the safe and immediate detection of any leak occurring in the jackets disposed in- side heterogeneous neutronic reactors are described. The control system and its operation for a reactor whose fis- sionable material is cooled by a series of fluid streams circulating through the reactor in heat-exchange relation- ship with the jacketed bodies consists of at least one detec- tor for determining the activity of the ionizing radiations. There are means for bringing representative samples of the fluid streams in front of the detector in order to permit the determination of the ionizing activity, and there are means for storing the successive indications of the detec- tor at a reference moment for a reference power of the reactor. There are means for determining the power of the reactor, means for correcting the stored indications so as to obtain corrected stored activities referred to the actual power of the reactor, means for comparing, for each fluid stream, the actual value of the ionizing activity of the stream, as determined by the detector to the corrected stored activity, and means for visualizing the difference between the actual value and the corrected stored activity for the fluid streams. (N.W.R.)

20928 NEUTRON-FLUX GAGE FOR NUCLEAR REACTORS. Karl Janner (to Siemens-Schuckertwerke A. G.). Canadian Patent 614,694. Feb. 14, 1961.

A neutron-flux gage for use with a nuclear reactor is described. The gage consists of a neutron-flux detector or probe, such as an ionization chamber or counter, which is enclosed in a jacket composed of three functionally dif- ferent layers. One of the layers consists of moderator substance of great diffusion length, such as graphite or beryllium. Another layer consists of reflector substance of smaller diffusion length, such as paraffin or polyeth- ylene. The third layer is a strong neutron absorber and may consist of a coating of boron. A gamma absorber plate, such as bismuth, is placed in front of the jacketed probe for increasing the sensitivity and/or the ratio of measuring value to noise level. The plate is mounted on the outer wall of the reactor. A fissionable material, such as a uranium plate, is mounted in front of the jacketed probe within the reactor vessel and preferably within the reflector zone of the reactor. This material increases the sensitivity of the detector. (N.W.R.)

20929 SPECIFIC RADIATION ABSORPTION CAPACITY MEASUREMENT OF A SOLID SUBSTANCE. Hendrik Dijkstra and Bauke S. Sleswerda (to Stamicarbon N. V.). Canadian Patent 617,563. Apr. 4, 1961.

A method and apparatus for automatically measuring the specific radiation absorption capacity per unit of mass of a solid substance is described. The steps involve directing a beam of penetrative radiation from a source into a weighed sample of finely divided substance, detecting radiation fränsmitted through the sample, and comparing photoelectrically the transmitted radiation with a second beam of the same radiation. A compensator is applied for automatically decreasing the intensity of the second radiation beam proportionally to the amount of radiation absorbed by the sample and converting the action of the compensator into a measuring impulse. The improvement in this method consists of spreading the sample into a long relatively thin layer, passing the sample layer lengthwise and at uniform velocity through the radiation beam applied for the sample irradiation, and integrating the successive actions of the compensator over the time necessary to effect passage of the sample layer through the radiation beam. An apparatus is designed for performing the above method. (N.W.R.)

20930 DEVICE FOR MEASURING THE RADIOACTIVITY OF LIQUIDS. Johannes Hermsen, Pieter J. Kraaijeveld, and Kars van Duuren (to N. V. Philips' Gloeilampenfabrieken). Canadian Patent 619,586. May 2, 1961.

A description of a Geiger-Mueller tube and a device using this tube for measuring the radioactivity of liquids and solids is presented. The discharge space of the tube is filled with a gas ions mixture containing at least 0.001% of a halogen and a rare gas and is surrounded by an envelope at least half of which consists of a material having a specific resistance 10^7 ohm cm and 10^{12} ohm cm and which is formed with a re-entrant part such that the discharge space has the form of a hollow shell with an annular neck terminating at the mouth of the re-entrant part. The discharge space is free from electrodes for the operation of the counting tube. One of the electrodes is directly associated with the envelope and is constituted by a conductive layer applied to the outer surface of the re-entrant part. The device consists of a vessel containing the liquid and the tube. The tube is disposed in the vessel so that the discharge space is substantially surrounded by the liquid with the mouth of the re-entrant part above the liquid level. The re-entrant part contains some of the liquid and the liquid is separated from the liquid in the vessel. One electrode is in contact with the vessel liquid and the other electrode is in contact with the liquid in the re-entrant part. A voltage source for operating the counter is connected to the electrodes. (N.W.R.)

Materials Testing

20931 (CNI-45) ESPERIMENTI DI DIFFUSIONE INTERMETALLICA. (Experimental Techniques of Intermetallic Diffusion). C. Bassani, P. Camagni, and S. Pace (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Sept. 1960. 20p.

Experimental methods used for a series of measurements on impurity diffusion in β–CuZn are described. Procedures involving the use of radiotracers, as well as

the analysis of relatively small penetrations by means of a conventional sectioning technique, are described. The purpose is to give an over-all picture of the experimental part of a study of the diffusion of Ag and Co in ordered β-brass. Some advance qualitative aspects of the results, which are related to the known behavior of self-diffusion in the same ordered alloy are given. (auth)

20932 (NP-10258) INTERFERENCE MICROSCOPY OF CRYSTALLINE HIGH POLYMERS. DETERMINATION OF THE THICKNESS OF SINGLE CRYSTALS. Technical Report No. 1. Bernhard Wunderlich and Peter Sullivan (Cornell Univ., Ithaca, N. Y.). May 30, 1961. Contract Nonr-401(44). 18p.

The use of interference microscopy for thickness determination of polymer single crystals is described. Polyethylene single crystals were used. Their average lateral dimensions were of the order of magnitude of 100,000 A. The crystals were deposited on microscope slides and the adhering solvent evaporated at room temperature. A value of 101 ± 6 A was obtained for the thickness. The agreement with the 94 A determined by x-ray determinations was satisfactory. (M.C.G.)

20933 (TID-12854) THE INFLUENCE OF THICKNESS-WISE TEMPERATURE GRADIENTS ON THE LARGE DEFLECTIONS AND STABILITY OF THIN ELASTIC SHELLS. PART I: SHALLOW CLAMPED SHELLS. PART II: COMPLETE SPHERICAL SHELLS, C. Libove. PART III: BIMETALLIC SHELLS. K. N. Tong (Syracuse Univ., N. Y.) Research Inst.)). Feb. 1961. For Oak Ridge National Lab. Contract W-7405-eng-26; Subcontract No. 913. 47p. (ME790-612T)

The non-linear deflections of thin elastic shallow shells (spherical and other) of uniform thickness, clamped at the boundary and subjected simultaneously to normal loading and temperature gradients through the thickness are considered. It is shown that a constant temperature gradient through the thickness of such a nature as to produce no cross-sectional thrust due to thermal expansion, has no influence on the deflections and stability, a (spatially) non-constant temperature gradient of the same kind can be replaced by an equivalent normal-pressure distribution, and a spherical shell with certain temperature distributions tending to produce thermal thrust can be replaced by an equivalent unheated shell of a different geometry and loading. The analysis is based on Von Karman's large-deflection theory for flat plates, generalized to include small initial curvature and thermal deformations. Complete spherical shells having a constant temperature gradient through the thickness and subjected to external hydrostatic pressure combined with a pair of concentrated forces applied radially inward at the ends of a diameter are also studied. It is shown that the temperature gradient can have only a negligible influence on the axi-symmetric classical buckling pressure under hydrostatic pressure alone, the post-buckling axi-symmetric large deflections under hydrostatic pressure alone, and the axi-symmetric large deflections under the hydrostatic pressure plus concentrated loading. The analysis is based on a study of Eric Reissner's differential equations for large deflections of rotationally symmetric shells, generalized to include temperature strains. The implication of results is that a uniform temperature gradient will not alter the stability analysis of spherical shells based upon the concept of the existence of non-adjacent equilibrium states. The test results generally supported the conclusion. (auth)

20934 (AEC-tr-4624) LAWS GOVERNING NON-UNIFORM DEFORMATION IN UPSETTING. Ya. M. Okhrimenko. Translated from Kuznechno-Shtampovochnoe Proizvodstvo, 1-5(Dec. 1959). 8p.

Investigations of the variation in non-uniformity in deformation during upsetting were conducted with cylindrical test pieces with various ratios between the initial dimensions. The upsetting process was carried out on steel test pieces on a friction press with heating of the test-pieces to 1000°C. Graphs plotted on the basis of the data obtained show the relationship between the absolute non-uniformity in deformation and the degree of deformation of the test pieces. When upsetting test pieces with a dimensional ratio of 0.5, the non-uniformity in deformation was characterized by three deformation zones: two contact zones I, in which deformation was made difficult, zone II, in which the deformation was chiefly concentrated, and zone III, in which these were tensile tangential deformations. The effects of chemical composition of the metal, contact conditions, and volume were investigated. (M.C.G.)

20935 (AEC-tr-4626) SOME ASPECTS OF HARDENING IN UPSETTING. V. A. Krokha. Translated from Kuznechno-Shtampovochnoe Proizvodstvo, 11-14(Dec. 1959). 6p.

The hardening of fastening heads and distribution of degrees of deformation in different zones of tail heads were considered. Fastenings of different types upset from steel were tested. Metallographic examinations were made at the same time as durometric tests. It was established that the hardness of the stems of headed bolts was greater than that of the billets. Measurements showed that the stem experienced uniform hardening throughout its length. It was determined that the hardness in the center of the heads was less than in the periphery by a mean factor of 3 units. Results of experiments to determine the hardness of the top of the heads of bolts showed that the greatest hardening is attained with flat heads, and the least when semi-circular heads are used. (M.C.G.)

20936 SPECIAL METHODS FOR NON-DESTRUCTIVE MATERIALS TESTING. H. J. Rodewald and C. Studer (Forschungsinstitut der Aluminium-Indistrie A. G., Neuhausen am Rheinfall, Ger.). Metall, 15: 410-14(May 1961). (In German)

Four methods of non-destructive materials testing are described. Special techniques of ultrasonic, penetration, x-ray, and microhardness testings are reviewed. (J.S.R.)

20937 INSPECTING URANIUM SLUGS AT HANFORD ULTRASONICALLY. Daniel C. Worlton (General Electric Co., Richland, Wash.). Nucleonics, 19: No. 6, 80-2(June 1961).

Pre-cladding tests on the Hanford fuel elements are described. An ultrasonic wave transmitted through the slugs gives information concerning grain orientation and size, core surface cracks, striations, seams, and other defects. The test results are compared with x-ray diffraction results and actual performance characteristics. (T.F.H.)

20938 A FEASIBILITY STUDY OF MODEL TESTING TO ESTABLISH THE VIBRATIONAL INTEGRITY OF REACTOR CORE COMPONENTS. J. A. Keane (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 63-4(June 1961).

20939 THE ELECTROMAGNETIC INSPECTION OF PRODUCTION QUANTITIES OF TUBING USED IN SOME REACTOR APPLICATIONS. C. J. Renken (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 137(June 1961).

20940 THE NON-DESTRUCTIVE TESTING OF ZIRCALOY REACTOR PROCESS TUBES FOR HIGH PRES-

RE, HIGH TEMPERATURE SERVICE. R. B. Socky eneral Electric Co., Richland, Wash.). Trans. Am. clear Soc., 4: No. 1, 137-8(June 1961).

941 U-235 CONTENT OF REACTOR FUEL ELE-ENTS BY SCINTILLATION SPECTROMETRY. N. S. yer (Argonne National Lab., Ill.). Trans. Am. Nuclear c., 4: No. 1, 138-40(June 1961).

20942 DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR THE REMOTE MEASUREMENT OF THE HOMOGENEOUS REACTOR TEST CORE VESSEL WALL THICKNESS. R. W. McClung and K. V. Cook (Oak Ridge National Lab., Tenn.). Trans. Am. Nuclear Soc., 4: No. 1, 140(June 1961).

GEOLOGY, MINERALOGY, AND METEOROLOGY

20943 (A/AC.82/G/L.578) ADVECTION OVER SWEDEN OF RADIOACTIVE DUST FROM THE FIRST FRENCH NUCLEAR TEST EXPLOSION. G. Lindblom (Sweden. Försvarets Forskningsanstalt, Stockholm). Feb. 1961. 18p.

An examination of the occurrence over Sweden of radioactive debris from the first French nuclear test in February 1960 was undertaken. The distribution of radioactive deposit was uneven. The time of arrival of debris was determined accurately and a comparison was made with meteorological parameters. Special autoradiographical and gamma-spectrometrical examinations were carried out which suggested that fractionation effects are present in the scavenging processes. (auth)

20944 (CNI-50) STRATIFICAZIONE DELLA RADIOATTIVITA ARTIFICIALE NEL SUOLO. (Distribution of Artificial Radioactivity in Soil). G. Dominici, A. Malvicini, and L. Vido (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Sept. 1960. 20p.

The radioactivity distribution in soil at various depths is described. The values of total beta radioactivity of the fission products in soil are compared with the value of activity of fallout collected with cylindrical pots at Ispra from Feb. 2, 1958. The fission product radioactivity was measured by a low-level large-surface scintillation counter. The activity of the most important radionuclides was determined in the first 5 centimeters of soil and it was found that about 90% of artificial radioactivity is concentrated in this layer. (auth)

20945 (NP-10217) THE WASHOUT OF AEROSOL PARTICLES AND GASES BY RAIN. Technical Report No. 88. Leland M. Vaughan and William A. Perkins (Stanford Univ., Calif. Aerosol Lab.). Jan. 1961. Contract DA-42-007-403-cml-448. 42p.

Calculation procedures were developed for estimating the washout loss for 1 to 5 μ particles and for water-soluble gases. For 1 to 5 μ particles, loss depends on the total precipitation and particle size. If, however, the particles are non-wettable, the washout loss is virtually zero. Two methods for computing losses are presented for gases in which infinite solubility and finite solubility of gases are assumed, respectively. The second method has greatest applicability. (D.L.C.)

20946 (NP-10290) A STUDY OF AURORAL X-RAYS AT MINNEAPOLIS BETWEEN 23 AUGUST 1959 AND 1 AUGUST 1960. Thomas C. May (Minnesota. Univ., Minneapolis. School of Physics). Apr. 1961. 64p. (CR-36)

The auroral x-ray occurrences detected by a balloon monitoring project between August 23, 1959 and August 1, 1960 are presented. The standard monitoring flight train consisted of a four-component detector unit, a pressure-measuring and cutdown timer device, a VHF transmitter with two FM–FM subcarriers, and an emulsion stack. Calculations of detector efficiencies to photons were made and these efficiencies used to explain experimental ratios of rates of the detectors to various photon spectra. Time-rate curves of the flights on which there were auroral x rays and magnetometer records of the earth's field are presented. During the time interval the magnetometer was operated 8050 hr. For a total of 134 hr the magnetometer deviated more than 100 γ's negative. About 83% of the 134 hr were within the 12 hr centered at local midnight. The negative excursions occurred on days of magnetic storms. Of the time the magnetometer was more than 100 γ's negative, there was a balloon at ceiling, with all of the detectors working, 38.5 hr. X rays were detected 64% of the time. On the other hand, there was a balloon at ceiling 447 hrs when the magnetometer was quiet and x rays occurred less than 1% of the time. Calculations are presented which show that the electron flux distribution which causes auroral x rays is much more intense at low energies than at high energies. Calculations were also made of the average electron flux above 20 kev for each burst, assuming that the flux distribution was of the form kE^{-3} and that the electrons were impinging on the top of the atmosphere over a large area above the balloon. Laboratory experiments which verified most of the procedures used in the calculations are discussed. The possible magnetic effects of the bremsstrahlung-producing electrons were also studied. (M.C.G.)

20947 (TID-12874) PROGRESS REPORT ON [UPPER ATMOSPHERE MONITORING], APRIL 1961. (General Mills, Inc., Minneapolis). Contract AT(11-1)-401. 40p.

Tests were carried out on a molecular sieve pump to determine adsorption rates. The design of a field-operational direct flow sampler which utilizes metal spinning techniques in fabrication is 80% complete. Initial results indicated that bacterial spores might be a convenient tracer for studying atmospheric circulation. The effect of ultraviolet radiation on bacteria was investigated. Lethal wavelengths for bacteria were found to exist between 2000 and 3300A with the most effective wavelength at 2537A. It appeared that the relative humidity is one of the chief controlling factors in the bacteria's susceptibility to ultraviolet radiation. It was found that regardless of where the organisms were disseminated into the atmosphere appreciable or complete kill would occur. Studies indicated that greater intensities of ultraviolet radiation in the more lethal wavelengths are present at higher altitudes. A filter study program was carried out to investigate the physical mechanisms responsible for collection of particulate material by fibrous filters. A theory for filtration by fibrous filters was developed based on consideration of three collection mechanisms: diffusion, interception, and inertial impaction. (M.C.G.)

20948 (AEC-tr-4623) SCINTILLATION TECHNOLOGY OF COUNTING NATURAL RADIOCARBON AND ITS APPLICATION IN DETERMINING ABSOLUTE AGE. I. E. (Ye.) Starik, V. P. Shamov, Kh. A. Arslanov, A. P. Zharkov, and G. (C.) M. Murashov. Translated by Al Monks (Oak Ridge National Lab.) from Radiokhimiya, 3: 101-13(1961). 18p.

A method developed for liquid scintillation counting of natural radiocarbon, designed to determine absolute age, is described. The chemical preparation of the samples consisted in separating the carbon as CO_2. The carbonate samples were decomposed with HCl and the organic samples were burned in an oxygen current to separate the CO_2. In the counting of C^{14} a coincidence–scintillation counter was developed. Use of benzene and ethylbenzene, synthesized according to the indicated scheme, as liquid-scintillation solvents, in conjunction with a highly effective counter, made it possible to determine absolute age up to 37,000 yr for ethylbenzene and to 48,000 yr for benzene. (auth)

20949 (CEA-tr-A-821) LA TENEUR EN TRITIUM DE L'ATMOSPHÈRE. (The Content of Tritium in the Atmosphere). V. Faltings and P. Harteck. Translated into French from Z. Naturforsch., 5: 438-9(1950). 6p.

It is shown that T exists in the free hydrogen of the atmosphere. Its β activity was measured. The atmospheric hydrogen was oxidized to H_2O which was then electrolytically concentrated. In 10 cm^3 of air about one atom of T was found. This represents about 1 mole in the atmosphere. (tr-auth)

20950 (CEA-tr-R-994) RECHERCHES AERINNES DES GISEMENTS D'URANIUM A L'AIDE D'UNE METHODE UTILISANT LES RAYONS GAMMA. (EXTRAIT DE "METHODES RADIOMETRIQUES DE RECHERCHES ET DE PROSPECTION DES MINERAIS D'URANIUM" CHAPITRE X). (Research on Aerial Uranium Deposits by a Method Using Gamma Rays (Taken from "Radiometric Methods of Research and Prospecting of Uranium Ores", Chapter X). G. S. Smirnov. Translated into French from Gosgeoltekhizdat, p.322-63, Moscow, 1957. 84p.

The separate sections of the chapter are devoted to: theoretical basis of gamma radiation aerial surveying, aerial radiometric apparatus, method of operation in aerial exploration, terrestrial verification and evaluation of occurrences showing, promise from γ aerial anomaly, and perfection and development of techniques for aerial research on U deposits. (T.R.H.)

20951 GAMMA-SPECTROMETRIC EXAMINATION OF PRECIPITATION SAMPLES WITH THE GRAY-WEDGE METHOD. R. Tzschaschel (Kernforschungsanlage, Jülich, Ger.). Atompraxis, 7: 170-2(May 1961). (In German)

Precipitation samples were collected weekly after the nuclear test explosion in the Sahara on Feb. 13, 1960, as an adjunct to zero-gauge monitoring. The γ activity of the evaporation residues was measured and the nuclide composition was determined by γ spectrometry. The results show close agreement with the findings of Habashi and Schönfeld, and also demonstrate the usefulness of gray-wedge γ spectrometry as a quick, reliable method for the qualitative determination of nuclide composition on a low level of activity. (auth)

20952 THE PROPORTION OF THORON SEQUEL PRODUCTS WITH AEROSOL ACTIVITY IN LOW-ALTITUDE AIR AND COMPARATIVE MEASUREMENTS WITH VARIOUS DEVICES. A. Maas (Kernforschungsanlage, Jülich, Ger.). Atompraxis, 7: 173-6(May 1961). (In French)

To determine the comparability of aerosol activity measurements made with filter devices of various manufacture, an apparatus (apparatus A) used by the atomic research center in Jülich during April and May, 1960, was compared with a second apparatus (apparatus B) used by the German Meteorological Service. After a waiting period of two days, the measurement results showed the following relationship: $activity_{(A)} : activity_{(B)} = 1 : 1.5$. Because of the parallelism in the course of the measurements of aerosol activities after 3 hours and 48 hours waiting time, the necessity is pointed out, in determining long-lived artificial radioactive substances in collected specimens, of having a waiting period of at least 4 days, since after a period of 2 days the proportion of thorium B (half life 10.6 h) can still amount to an important percentage, depending on the level of artificial radioactivity. (auth)

20953 THE POSSIBILITY OF UTILIZING THE DETERMINATION OF RADON OF SUBTERRANEAN WATERS IN THE PROSPECTION OF URANIUM DEPOSITS. Georges Jurian (Université, Nancy, France). Compt. rend., 252: 3090-2(May 15, 1961). (In French)

The determination of radon in subterranean waters permits an actual localization of the mineralized zones of uranium. Because of its sensitivity, rapidity, and low cost, this method can be placed within the general prospection scheme between strategic and tactical prospection. (tr-auth)

20954 COPPER, VANADIUM, AND URANIUM DEPOSITS IN SANDSTONE—THEIR DISTRIBUTION AND GEOCHEMICAL CYCLES. Richard P. Fischer and John H. Stewart (U. S. Geological Survey, Denver, and Menlo Park, Calif.). Econ. Geol., 56: 509-20(May 1961).

Deposits of copper, vanadium, and uranium in nonmarine sandstones are numerous and widespread. Copper deposits, with or without uranium, are mainly resident in first-generation arkosic sandstones derived from granitic rock terrains; deposits rich in vanadium, with or without much uranium, are dominantly in second-generation sandstones derived from sedimentary rocks; and the uranium deposits with little or no vanadium or copper are in either first- or second-generation sandstones, many of which are associated with beds containing volcanic debris. All three metals are dispersed in igneous rocks but not in close association. Copper and uranium enter the hydrothermal environment, but the record of vanadium in hydrothermal solutions and veins is scant. Some of the uranium and most of the copper minerals in igneous rocks and veins oxidize readily and the metals go into surface- and ground-water solutions, but the vanadium in igneous rocks is not so easily mobilized—under normal geologic conditions, conceivably it may require diagenetic reactions and a second period of weathering to solubilize much vanadium. All three metals precipitate from solutions in the presence of a reducing agent, such as carbonaceous material or associated sulfide ions, either in sediments as they accumulate or in existing rocks. These geochemical habits permit the concept that copper and uranium are made available by weathering of igneous rock terrains and hence might accumulate in first-generation sediments, whereas vanadium would be commonly available only after a second period of weathering. Perhaps the oxidation or devitrification of volcanic debris may contribute uranium to ground waters as does the weathering of igneous rocks. (auth)

20955 RADIOACTIVITY AND TERTIARY VOLCANIC ACTIVITY IN EGYPT. Amin R. Gindy (Alexandria Univ., UAR). Econ. Geol., 56: 557-68(May 1961).

Tertiary tectonic disturbances in Egypt produced widespread basaltic fissure eruptions and diverse hydrothermal activities that include copper, iron, iron-manganese, and lead-zinc mineralizations. Studies on the trace radioactivity of some of these deposits suggest the presence of a weak uraniferous phase in some or in certain stages of these hydrothermal activities, and can explain the known occurrences of economic uranium deposits in Egypt. These volcanic hydrothermal solutions were not originally uraniferous but have become so during their ascent by leaching and mobilizing preexisting labile uranium and other ions in the traversed rocks. (auth)

20956 RECOVERY OF URANIUM FROM SPANISH MINERALS. José María Josa García, Eleuterio Escudero Saiz, and Gervasio Cordero Gómez (Junta de Energía Nuclear, Madrid). Energia nuclear (Madrid), 5: No. 17, 49-56(Jan.-Mar. 1961). (In Spanish)

The conditions necessary for the dissolution of uranium minerals from Andalucia, Extremadura, and Salamanca are indicated. In determining these conditions, use was made of statistical methods. The complete analysis of one case and a discussion of the testing techniques are included. The typical deviation for a simple test is 1.2%. (tr-auth)

20957 QUANTITATIVE INTERPRETATION OF GAMMA-RAY LOGS. J. H. Scott, P. H. Dodd, R. F. Droullard, and P. J. Mudra (U. S. Atomic Energy Commission, Grand Junction, Colo.). Geophysics, 26: No. 2, 182-91(Apr. 1961). (RME-136)

A quantitative method for determining the concentration of γ emitting elements in layered rocks penetrated by boreholes. It is based on the relationship $\overline{GT} = k \int_{-\infty}^{+\infty} Idz$, where G is the mean thickness T, k is a constant of proportionality, and I is the intensity of the γ field along the borehole axis at a distance z from a fixed point of reference on the axis. This relationship was confirmed theoretically and empirically. In application, the grade-thickness product of a mineralized zone intersected in the borehole is determined by multiplying the area under the γ log curve by a constant of proportionality. The mean grade of the zone is determined by dividing the grade-thickness product by the zone thickness. Corrections applied for nonstandard conditions in the borehole reduce the data to equivalence with standard calibration conditions. Because the volume sampled in this logging method is significantly larger than that of core samples, the resulting data are more representative than data from chemically-assayed core. (auth)

20958 FALLOUT AND NATURAL BACKGROUND IN THE SAN FRANCISCO BAY AREA. Lloyd D. Stephens, H. Wade Patterson, and Alan R. Smith (Univ. of California, Berkeley). Health Phys., 4: 267-74(1961).

On or about 20 March 1958 a significant increase in the background radiation levels was noticed at the University of California Radiation Laboratory. It was soon determined that this increase was associated with radioactive material deposited during a series of rainstorms. A series of measurements was made in order to contribute to the assessment of the extent and amount of the deposited radioactivity. The instrument used for the field surveys was a NaI(Tl) crystal 3 in. long by 3 in. in diameter and viewed by a DuMont K1197 phototube, the output of which drives a count-rate meter. This same crystal was used for γ pulse-height analysis in conjunction with a 50-channel pulse analyzer. Sample counting is done inside of a 4 in. thick lead shield. In making the survey, the points were chosen to be as evenly spaced and as representative of altitude, rainfall, and rural and urban areas as possible. One area, an area of dense fern growth, showed the highest radiation levels and it was decided to use this fern for pulse-height analysis. Samples were ashed and then analyzed. The results confirmed fall-out-produced radiation. The prominent peaks at 0.15, 0.49, and 0.75 Mev are characteristic of fall-out spectra of this age. The 1.62 Mev La^{140} peak was also present. The results allowed the establishment of a value for the natural background radiation for these areas as none was available prior to the deposition of the fall-out. By the use of γ spectroscopy in conjunction with a γ dose field survey, it is possible to measure changes in the radiation level due to fall-out that in magnitude do not exceed 10% of the natural background. A continuing program is being carried out both in the field surveys and the spectroscopy. (auth)

20959 A RADIOMETRIC METHOD OF ANALYSIS OF NATURAL RADIOACTIVE ELEMENTS BY GAMMA-RAY SPECTROMETRY AND APPLICATION TO GRANITIC ROCK SAMPLES. Shun-ichi Sano and Junji Nakai (Geological Survey of Japan). J. At. Energy Soc. Japan, 3: 288-95 (Apr. 1961). (In English)

A method of analysis of natural radioactive minerals using γ spectrometry is developed, designed so as to be applicable to the special case in which the radioactive elements are not in equilibrium. The method is applied to the analysis of granitic rock samples in which sedimentary uranium deposits are distributed. (auth)

20960 DETECTION AND MEASUREMENT OF THE NATURAL RADIOACTIVITY OF THE ATMOSPHERE. Daniel Blanc, Jacques Fontan, René Soulhier, and Gilbert Vedrenne (Faculté des Sciences, Toulouse, France). J. phys. radium, 22: 50-8(Jan. 1961). (In French)

After recalling the nature of natural atmospheric radioactivity, the various methods of detection and dosimetry of this radioactivity, such as direct methods (ionization chamber, proportional counter, and scintillator) and indirect methods (thermal, centrifugal and electrostatic precipitations, and filtration), are surveyed. Finally, taking into account the diffusion of the emanation and the meteorological conditions that modify the natural radioactivity of air, the order of magnitude of this radioactivity is given. (auth)

20961 IDENTIFICATION AND MEASUREMENT OF Be^7 IN FALL-OUT. G. Dominici, P. Gaglione, A. Malvicini, and L. Vido (Centro di Studi Nucleari, Ispra, Italy). Minerva nucleare, 5: 52-4(Feb.-Mar. 1961). (In Italian)

The identification of Be^7 in fall-out collected monthly at Ispra and the method used for its chemical separation are described. The values observed in July, August, September, and October, 1960, are reported. The gamma activity due to Be^7 in the rain collected in October was greater than that due to fission products. (auth)

20962 SEASONAL VARIATION AND AGE OF RADIOACTIVE FALL-OUT. R. P. Parker and J. O. Crookall (Royal Cancer Hospital, London). Nature, 190: 574-6(May 13, 1961).

Seasonal variations in the concentration of long-range fall-out material are discussed, and various meteorological conditions which may account for a spring maxima are reviewed. Data are tabulated from measurements of Sr^{90} in rain samples collected in Great Britain during 1960, specific concentrations of Rh^{106}, Sb^{125}, Cs^{137}, and Ce^{144} in fall-out samples, and the fission yield for various types of fission. From calculations based on available information on the dates of megaton explosions, it is concluded that the majority of the fall-out material originated from American and British equatorial tests of 1958. Discrepancies in the yield of Sb^{125} and Rh^{106} were found. It is concluded that these discrepancies may be explained if, in addition to the 14-Mev fission of U^{238}, other fission processes are involved. (C.H.)

20963 MEASUREMENTS OF AIR RADIOACTIVITY IN ITALY AND THEIR RELATION TO THE FIRST SAHARA ATOMIC EXPLOSION. L. Argiero, S. Manfredini, and G. Palmas (C.A.M.E.N., Livorno, Italy). Nature, 190: 618-19(May 13, 1961).

On the occasion of the French atomic explosion of Feb. 13, 1960, in the Sahara, a system for monitoring radioactivity in the air was set up covering the whole of Italy. Results of measurements of air activity are tabulated. (C.H.)

20964 ARTIFICIAL ELECTRON CLOUDS. IV. THERMAL IONIZATION STUDY. NIGHT TIME CESIUM RELEASE AT 101 km. J. Pressman, F. F. Marmo, and L. M. Aschenbrand (Air Force Cambridge Research Center, Bedford, Mass.). Planetary Space Sci., 2: 17-25(1959).

Radio-radar and optical observations of an electron cloud created by the night time release of cesium at 101 km from a rocket are reported. An analysis of the electron yield based upon the thermochemistry and the Saha relationship indicates that the electrons observed can be reasonably ascribed to thermal ionization. (auth)

20965 THE RIVERVIEW MINE, COCONINO COUNTY, ARIZONA. William L. Chenoweth and Page P. Blakemore (U. S. Atomic Energy Commission, Flagstaff, Ariz. and Cameron Mining Co., Ariz.). Plateau, 33: 112-14(Apr. 1961).

One of the most unusual uranium occurrences in the Cameron mining area is the Riverview Mine, located in the central part of Section 8, T. 26 N., R. 10 E., Coconino County, Arizona. At this mine, uranium occurs in a collapsed pipe structure which is located on the Black Point segment of the East Kaibab monocline at a point where the monocline is sharply deflected to the southwest. The Riverview pipe is elliptical in outcrop being about 90 by 140 ft with the elongation in a north-south direction. Recent drilling has indicated that the pipe flares slightly at depth and rakes to the southeast. The mine was located in August 1956, and several hundred tons of good uranium ore, low in vanadium, have been produced. (auth)

20966 RADIOCARBON CONCENTRATION IN PACIFIC OCEAN WATER. G. S. Bein, N. W. Rakestraw, and H. E. Suess. Tellus, 12: 436-43(Nov. 1960).

Results of C^{14} determinations in surface water from the Pacific were in agreement with those reported by Rafter and Fergusson. However, abnormal C^{14} concentrations seem to exist locally, for which no oceanographic explanation can be given. It seems premature to draw conclusions from existing determinations as to the rate of increase of C^{14} produced in the atmosphere by atomic bombs. Samples from a constant depth of about 3,500 meters show a C^{14} content decreasing from south to north. This decrease may be attributed to radioactive decay of C^{14} during the time of migration. From this the northward component of the rate of water movement of about 0.06 cm/sec can be calculated. The C^{13} determinations, for the purpose of correcting the C^{14} values for isotope fractionation effects, were found to be remarkably consistent, although made on reburned acetylene. (auth)

20967 IRON ORE ANALYSIS UTILIZING NEUTRON CAPTURE GAMMA-RAYS. R. C. Greenwood, J. Reed, and C. A. Stone (Armour Research Foundation, Chicago). Trans. Am. Nuclear Soc., 4: No. 1, 127(June 1961).

20968 THE RADIATION AGE OF IRON METEORITES FROM CHLORINE-36 MEASUREMENTS. Else Vilcsek and H. Wänke (Max-Planck-Institut für Chemie (Otto-Hahn-Institut), Mainz). Z. Naturforsch., 16a: 379-84(Apr. 1961). (In German)

Chlorine-36, produced by the interaction of cosmic particles with nuclei in meteorites, was measured in seven iron meteorites and in one stone meteorite. The decay rates for chlorine-36 in iron meteorites varied between 1.5 and 20.2 dpm/kg. From these and from the concentration of stable spallation products, the exposure ages of these meteorites were calculated. In this way it was found for six of the meteorites examined exposure ages close to 500 million years. Only for the Sikhote Alin meteorite the quite different exposure age of 60 million years was measured. As this value is also definitely lower than that found by other authors for this meteorite, it is suggested that the Sikhote Alin had been part of a bigger meteorite which was broken into pieces about 60 million years ago by a collision with another meteorite. (auth)

20969 CONCERNING Xe^{129} IN THE METEORITE ABEE. P. M. Jeffrey and J. H. Reynolds (Univ. of California, Berkeley). Z. Naturforsch., 16a: 431-2(Apr. 1961). (In English)

The results recently reported by Zahringer and Gentner from an experiment in which the rare gases expelled at successively higher temperatures from the powdered meteorite were examined mass spectroscopically are discussed. Because of these results and the conclusions drawn, the experiment was repeated. The steps taken to reduce atmospheric contamination are described. The results are graphed, and curves for Ar and Xe^{132} evolution are in general agreement with the previously obtained curves. The curve, however, for the Xe^{129}/Xe^{132} ratio of the evolved gas is strikingly different. The ratio has temperature variations which are far beyond the possible limits of experimental error. It is suggested that there are phases in the meteorite with a marked excess of Xe^{129}, and that these are the iodine-bearing phases. (J.S.R.)

20970 NEUTRON GENERATOR. Adrianus C. Van Dorsten and Otto Reifenschweiler (to N. V. Philips'-Gloeilampenfabrieken). Canadian Patent 616,006. Mar. 7, 1961.

A neutron generator of simple construction which needs only one high-voltage supply lead is described. Such generators are used for testing bore holed. The generator consists of a gaseous deuterium filled envelope. There are means within a portion of the envelope for producing a glow-discharge consisting of a cathode having a plate-shaped portion and a second cathode having a plate-shaped portion provided with an aperture and arranged parallel to the first portion. A cylindrical anode is centrally disposed between the cathode portions. There are magnetic means for producing a magnetic field which extends perpendicular to the cathode portions. There is a tritium-coated target within the second portion of the envelope and disposed to be struck by ions produced by the glow-discharge. There are means to accelerate the ions produced in the discharge toward the target to effect a nuclear reaction, and magnetic shielding means surrounding the glow-discharge for the passage of ions produced by the glow discharge. (N.W.R.)

HEALTH AND SAFETY

20971 (CWR-400-34) REPORT OF THE ENVIRONMENTAL MONITORING PROGRAM FOR THE CURTISS-WRIGHT RESEARCH REACTOR AND NUCLEAR FACILITY (MONITORING TO JANUARY 1, 1958). J. L. Donovan and C. E. Roessler (Curtiss-Wright Corp. Research Div., Quehanna, Penna.). Jan. 11, 1960. 42p.

Development of an environmental monitoring program for the Quehanna site of the Curtiss-Wright Corporation is presented. Other factors such geographical, geological, hydrological, and meteorological aspects of the site are also examined along with the effects of population density. Results of environs sampling analysis of beta activity from 1956 to 1958 are included. (J.R.D.)

20972 (HW-SA-1957) INADEQUACIES OF MPC's FOR CONTROL OF RADIATION IN THE ENVIRONMENT. P. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 19p.

Presented at the Annual Meeting of the Pacific Northwest Local Section of the American Industrial Hygiene Association, September 9 and 10, 1960, Richland, Wash.

The broad application of Maximum Permissible Concentrations to media near the source fail to define adequately either the source or the magnitude of the exposure which may be received by man or animals. Improved control can be accomplished by reliance on measurements made on those foodstuffs which are actually consumed by man, but variation in eating habits and other activities between individuals obviates the desired precision. Only by treating each situation as a special case and carefully evaluating the importance of each of the many potential sources of exposure can a realistic set of operating controls be developed for major atomic energy installations. (auth)

20973 (NP-10227) ENERGY SPECTRUM OF ELECTRONS TRAPPED IN GEOMAGNETIC FIELD. Technical Report 216. Martin Walt (Lockheed Aircraft Corp. Missiles and Space Div., Palo Alto, Calif.) and William M. MacDonald (Lockheed Aircraft Corp. Missiles and Space Div., Palo Alto, Calif. and Maryland. Univ., College Park). May 1961. Contract Nonr 1797 (00). 17p.

A Fokker-Planck equation for the distribution function of electrons trapped in a magnetic field in the presence of a scattering atmosphere was applied to the Van Allen electron belt. Solutions were obtained for the equilibrium flux resulting from an electron source of arbitrary energy for the cases where loss of energy by collisions is neglected and loss by diffusion out of the trapping region is neglected; and an approximate solution was obtained for the actual case where both processes are considered. The assumption that the electron source is supplied by decaying neutrons led to an equilibrium electron flux whose energy dependence is qualitatively different from the observed spectrum. (auth)

20974 (NP-10264) PROCEEDINGS OF TRIPARTITE SYMPOSIUM ON TECHNICAL STATUS OF RADIOLOGICAL DEFENSE IN THE FLEETS, MAY 16–20, 1960. VOLUME I. REVIEWS AND LECTURES NO. 103. (Naval Radiological Defense Lab., San Francisco). 194p.

Ten papers are included which were presented at the Tripartite Symposium on Technical Status of Radiological Defense in the Fleets. The topics covered ranged from radionuclide fractionation in underwater bursts to radiation hazards and contamination of ships. Separate abstracts have been prepared for each of the papers. (D.L.C.)

20975 (NP-10264(p.1-31)) THE MECHANISM OF SURGE DISSIPATION. H. W. Pyne (Gt. Brit. Armament Research Establishment, Fort Halstead, Kent, England).

This paper is a presentation of a report produced by E. P. Hicks and W. G. Penney, entitled "The Base Surge: The Mechanism of Fallout."

In the underwater nuclear explosion at Bikini (test Baker), a heavy mist or base surge spread rapidly from the base of an opaque vertical column of fine water drops thrown from the point of explosion. Rain was observed to fall from the bottom of the surge at ~3 min after explosion, and the spreading slowed down and finally stopped after another 2 min. The mechanism of rain fall-out from the surge is discussed. Theoretical studies of the problem indicate that the fine water droplets should have coagulated to large raindrops by a time which agrees well with that at which rain was observed in the bottom of the surge. The early stages of droplet growth appear to be controlled by evaporation and condensation of water vapor, but most of the growth is subsequently caused by collisions of droplets of different size. (D.L.C.)

20976 (NP-10264(p.33-45)) FRACTIONATION CORRELATIONS. E. C. Freiling (Naval Radiological Defense Lab., San Francisco).

Fractionated samples of nuclear detonation debris can be correlated in terms of f_i and f_{89}, the number of device fissions required to produce the radionuclide activities of mass i and 89 found in the samples, respectively. The correlations are best put in the form of $r_{i,89}$ vs $r_{95,89}$ logarithmic plots, where $r_{i,89} = f_i/f_{89}$ and $r_{95,89} = f_{95}/f_{89}$. Results of such correlations are presented for surface bursts of different kinds (coral surface, sub-megaton deep-water surface, deep-water surface, and shallow-water surface). 95% confidence limits of the slopes and intercepts of the plots were calculated, and the largest discrepancy is due to the high-yield deep-water surface burst. Cumulative slopes are correlated with precursor volatility. Correlation slopes for subsurface bursts are presented along with data for a shallower underwater burst and a lagoon burst. It is concluded that, as depth increases, all radionuclides tend to behave more like Zr^{95} and less like Sr^{89} and that the degree of fractionation increases in the order: high-yield deep-water surface burst < sub-megaton deep-water surface burst ≅ deeper underwater burst < shallower underwater burst. (D.L.C.)

20977 (NP-10264(p.69-97)) CHARACTERISTICS OF RADIATION FROM NUCLEAR WEAPON DEBRIS. Robert L. Mather (Naval Radiological Defense Lab., San Francisco).

The nuclear radiations from nuclear weapon debris constitute an important hazard, chiefly from the gamma rays. Very complicated processes determine the amount and kind of radioactivities in the fall-out and their distribution over the surroundings. Gamma-ray energy spectra observed as a function of time and from a relatively even distribution on level ground are presented. (D.L.C.)

20978 (NP-10264(p.99-133)) EXPERIMENTAL AND THEORETICAL SHIELDING PROGRAM. W. E. Kreger (Naval Radiological Defense Lab., San Francisco).

In order to evaluate the potential hazard to Naval personnel due to radiation from nuclear weapons, a program was initiated to develop input data and calculational procedures for determining the shielding effectiveness of ship

structures. In this program, dose contributions at points in the ships from various source points in space are summed to yield the total dose at each point. Some of the dose results are presented. Data on gamma-ray penetration through finite plane slabs of aluminum and steel are also reported. The theoretical phase of the program, intended to compare measurements and to determine the validity of calculational procedures, is described. (D.L.C.)

20979 (NP-10264(p.173-85)) THE EFFECTS OF COLD WEATHER. PART II. THE FALLOUT HAZARD IN ICING CONDITIONS. T. A. Harwood (Canada. Defence Research Board).

The possible problems involved in ships traversing contaminated seas after nuclear explosions in icing conditions are discussed. Ice can form on ship superstructures from flying spray, and radionuclides can be expected to be incorporated therein. Maps of areas of possible superstructure icing are included. A study of the properties of brine ice and frozen atomized salt solution indicates that frozen spray should lose brine by seepage for several days and that contamination of the ship by such brine would be a severe problem. (D.L.C.)

20980 (UCRL-6220) HAZARDS SUMMARY REPORT FOR THE LRL CRITICAL FACILITY. James Carothers (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 3, 1960. Contract W-7405-eng-48. 142p.

The Lawrence Radiation Laboratory has, since 1952, operated a critical facility at the Livermore Site. The two original assembly vaults are still in continuous operation in support of the weapons and propulsion reactor programs of the laboratory. An additional critical assembly cell was recently completed to provide more facilities for critical assembly measurements. This cell is unusual in that it is in a containment building which can be sealed to prevent release of any radioactive or toxic material to the atmosphere. Typical moderated and unmoderated core assemblies are explained and analyzed to demonstrate the procedures at the LRL critical facility. Credible accidents are shown to be less than 10^{18} fissions for these systems. The safety features of both the old and new cells are shown to have an adequate margin to contain all consequences of such accidents, including prompt and delayed radiation, fission products, and any dispersed core material. (auth)

20981 (AEC-tr-4630) SELECTIVE MEASUREMENT OF NEUTRON AND PHOTON DOSES WITH AN ETHYLENE DOSIMETER. Franz Ph. Pott and Siegfried Wagner. Translated for Oak Ridge National Lab. from Nukleonik, 2: 271-6(1960). 27p. (Includes original 6p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14486.

20982 (CEA-tr-A-782) DOSAGE DE LA RADIOACTIVITE DES EAUX SOUTERRAINES ET DE SURFACE. (Determination of the Radioactivity of Subterranean and Surface Water). E. Wosahlo. Translated into French from Gas-u. Wasserfach., 99: No. 14, 322-4(1958). 14p.

A method is given for measurement of radioactivities below 10^{-7} microcuries/ml in subterranean and surface water. After 3 evaporations the dry residue is dissolved in concentrated HCl, the insoluble portion being fraction 1. Ba, Ca, and Sr are precipitated then as sulfates (fraction 2) and filtered off. K is then separated from the filtrate as $KAl(SO_4)_2$ (fraction 3). After SO_4 removal by $BaCl_2$, and Al removal by NH_4OH, the Mg and other remaining elements dissolved in the water (fraction 4) are precipitated after evaporation of NH_4Cl. This procedure offers the advantage of minimal use of reagents which would introduce activity. The Sr can be separated by triple evaporation to dryness with concentrated HNO_3, removal of insolubles (fraction 1), extraction of $Ca(NO_3)_2$ in absolute alcohol and ether followed by reprecipitation as oxalate and weighing as CaO (fraction 2). Then the Ba is precipitated as chromate, filtered, dissolved in HNO_3 and determined as sulfate (fraction 3). The Sr in the filtrate is isolated as sulfate. (T.R.H.)

20983 RADIATION DOSES TO THE GONADS OF PATIENTS IN SWEDISH ROENTGEN DIAGNOSTICS. STUDIES ON MAGNITUDE AND VARIATION OF THE GONAD DOSES TOGETHER WITH DOSE REDUCING MEASURES. Lars-Eric Larsson (Karolinska Sjukhuset, Stockholm). Acta. Radiol., Suppl. 157, 1-127(1958). (In English)

Measurements were made of the gonad doses in persons undergoing diagnostic roentgen examinations in Sweden. The age and sex distribution for the various examinations was determined, and factors influencing the radiation doses were surveyed. The genetically relevant average gonad dose received by the population annually from medical roentgen diagnostics was calculated. Possibilities are suggested for reducing the gonad dose. (C.H.)

20984 DATING OF BLACK SHALES. James C. Cobb (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 91: 311-16(Apr. 3, 1961). (BNL-4822)

Studies on uranium-lead dating of black shales on the Upper Devonian Chattanooga shale and the Upper Cambrian Swedish alum shale are presented. From these studies the ages are estimated to be 320 to 350 m.y. for the Chattanooga shale and 500 m.y. for the Swedish alum shale. The principal problems of U-Pb dating and its possibilities are discussed. The principal cause of discordant ages is ground-water leaching. Radium and lead are most susceptible to this effect. Deep samples from drill cores are likely to show less leaching effects than surface samples. If only U^{238}/Pb^{206} ages can be obtained, they are probably minimum. If the horizon is high enough in uranium to calculate three isotopic ages, this can be of assistance in determining what has happened. Younger samples than Paleozoic would be very difficult to use because of the high common lead correction required. (N.W.R.)

20985 DATING OF TERTIARY VOLCANIC ROCKS BY THE POTASSIUM–ARGON METHOD. O. A. Schaeffer, R. W. Stoenner, and W. A. Bassett (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 91: 317-20 (Apr. 3, 1961). (BNL-4787)

The possibility of using volcanic glasses for potassium–argon dating is investigated. The following properties must be available in the mineral: it should be relatively widespread in natural settings; it should be completely outgassed of argon at the time of the geological event it is to mark; it should undergo little loss of argon by diffusion; and it should contain a reasonable amount of potassium. From the mass spectrometer measurements made in this preliminary investigation it is concluded that volcanic glasses have a good possibility of being a useful mineral for K–Ar dating, provided that samples are taken only from fairly large specimens. (N.W.R.)

20986 STUDY OF THE CONTAMINATION OF AN ARTIFICIAL BIOCENOSITE OF SOFT WATER BY RADIOACTIVE CERIUM. Yves-Alain Fontaine and André Aeberhardt (Muséum d'Histoire Naturelle, Paris and Centre d'Etudes Nucléaires, Saclay, France). Compt. rend., 252: 3151-3(May 15, 1961). (In French)

After realizing a complex community comparable to a sea of soft water, the radioisotope Ce^{141} was introduced and its distribution followed for 41 days. The irradiation experienced by the organisms can be estimated as a function of the intensity of the initial contamination. (tr-auth)

20987 SOME CONSIDERATIONS ON EXPOSURE TO IONIZING RADIATION. N. Castellino (Università, Naples). Folia Med. (Naples), 44: 89-120(Feb. 1961). (In Italian)

In view of the new directives established by the Council of the Atomic Energy European Community for the medical protection of the populations and workmen against the dangers from exposure to radiation, the following are discussed: the present possible causes of exposure in the various employments in industry and medicine, in the different uses for research purposes and in all the conditions in which atmospheric pollution occurs; the immediate and late biological effects deriving from exposure to radiation, taking into account the varying risks and the extent of damage, both factors being related to the way in which irradiation occurs as well as to the nature and power of the radiation; and the principles on which medical protection of the workers must be based, namely the means for physical protection used against radiations, on one hand, and, on the other hand, medical control effected through medical examination before employment, as well as periodical and special examinations. (auth)

20988 SEISMIC DECOUPLING FOR EXPLOSIONS IN SPHERICAL CAVITIES. W. M. Adams (Univ. of California, Livermore) and D. S. Carder. Geofis. pura e appl., 47: [No. 3], 17-29(1960). (In English). (UCRL-5917)

A series of paired explosions in a salt mine near Winnfield, Louisiana, was conducted to test a theory by Dr. A. L. Latter concerning seismic decoupling by underground cavities. The theory predicted a decoupling of about 100. Free-field and surface measurements from an explosion in either a 6 ft or a 15 ft radius spherical cavity were compared with similar measurements from a completely tamped explosion. Shot sizes were from 20 lb up to a few tons. Surface measurements were made out to 100 km and covered the frequency range from 0.5 to 100 cps. The experiment confirmed that decoupling does occur. The actual decoupling factor as a function of frequency is presented and compared with the Latter theory. (auth)

20989 THE HAZARDS OF SCATTERED RADIATION FOR MEDICAL PERSONNEL DURING ROENTGENOSCOPY. F. Minarik, K. Dearchek, and A. Minarik. Gigiena Truda i Professional. Zabolevaniya, 4: 11-17(1959).

Equal intensity curves are employed for the study of distribution of scattered x radiation. It is established that the only safe place is behind the screen. With the higher potentials (80 kv.), radiation reaches the edges of the screen. The areas on either side of the apparatus and behind the tube cannot be considered quite safe. The members of the staff who support the patient and administer the contrast media, are exposed to the greatest danger. The intensity of scattered radiation increases with the potential reaching the tube, with the size of the picture on the screen and with the displacement of the main beam toward the peripheral parts of the patient's body. (auth)

20990 SYMPOSIUM ON THE EFFECT OF THE RECOMMENDATIONS OF THE NATIONAL COMMITTEE ON RADIATION PROTECTION (NCRP) ON NATIONAL LIFE. H. P. Yockey (Aerojet-General Nucleonics, San Ramon, Calif.). Health Phys., 4: 205-22(1961).

The National Committee on Radiation Protection (NCRP) was founded as a result of the need for the establishment of acceptable standards for x radiation and internally-deposited radioactive material. The effects of NCRP recommendations on national life are reviewed from the standpoint of the safety of industrial employees, legislative control of radiation, applications of radiation in medicine, and effects on insurance rates for nuclear industries. (C.H.)

20991 CALCULATIONS OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOACTIVE FALLOUT IN WATER AND AIR BASED UPON MILITARY EXPOSURE CRITERIA. J. D. Teresi and C. L. Newcombe (Naval Radiological Defense Lab., San Francisco). Health Phys., 4: 275-88(1961).

Computations are tabulated for maximum permissible concentrations (MPC) of radioactive fall-out in water and air for consumption during selected periods at designated times after burst to meet specified dose criteria, namely, 15 rems in 90 days and 150 rems in 30 days. The MPC values obtained may be used directly to obtain values for other doses during the same periods of 30 and 90 days by simply using the appropriate factor. For example, the MPC for a dose of 1.5 rem in 90 days is one-tenth the tabulated value for 15 rems. The fourteen major radionuclides of the fall-out are evaluated in terms of their individual contributions under varying situations to the radioactivity of the fall-out mixture. Only limited, unofficial MPC data were available for single exposures, hence in the computations, emphasis was given to exposure periods ranging to 90 days. The calculations for radioactive fall-out are based upon the critical organ yielding the smallest MPC for each element. The study shows that, in general, the principal contributors in the fall-out mixture to the dose to internal body parts during the first seven days after burst are: I^{131}, Np^{239}, Ba^{140}, La^{140}, Sr^{89}, Zr^{95}, Nb^{95}, and Y^{91}. The main contributors from 8 to 105 days after burst are: I^{131}, Sr^{89}, Ce^{144}, Pr^{144}, Ba^{140}, La^{140}, and Y^{91}, whereas Sr^{89}, Ce^{144}, Pr^{144}, Zr^{95}, Nb^{95}, Sr^{90}, Y^{90}, and Y^{91} are the principal contributors from 105 days to 365 days after burst. (auth)

20992 MAXIMUM PERMISSIBLE ACTIVITY (MPA) FOR FISSION PRODUCTS IN AIR AND WATER. D. L. Summers and M. C. Gaske (Air Force Special Weapons Center, Albuquerque, N. Mex.). Health Phys., 4: 289-92(1961).

When mixed fission products are present in air and water, the maximum permissible activity (MPA) is dependent on the relative activity of the individual isotopes. This, in turn, is dependent on the age of the products. The MPA can be determined most accurately from measurements of the isotopic concentrations; however, the separation of mixed fission products into their constituent activities is extremely complicated and costly. In order to provide a simple method of evaluating the internal radiation hazard, MPA's for an ideal mixture of fission products vs. its age were calculated and plotted. The resulting curves show that the MPA's change appreciably with time. Between 1 day and 3 years for 40 hr per week occupational exposure, they decrease from 2.7×10^{-7} to 1.2×10^{-9} $\mu c/cm^3$ (microcuries per cubic centimeter) for air, and from 1.6×10^{-3} to 1.7×10^{-5} $\mu c/cm^3$ for water. From the curves a first approximation of the MPA's and therefore the allowable fission product activity in air and water, can be obtained. In order to use the curves, one needs to know only the disintegration rate per unit volume and the approximate age of the products. (auth)

20993 NOTE ON THE ICRP AND NCRP RECOMMENDED $(MPC)_a$ FOR INSOLUBLE Ra^{226} COMPOUNDS. S. R. Bernard and M. R. Ford (Oak Ridge National Lab., Tenn.). Health Phys., 4: 307-8(1961).

The maximum permissible concentration (MPC) for insoluble compounds of Ra^{226} was calculated using lung

as the critical organ. It is suggested that 30% retention of Ra daughters be assumed for lung-stored Ra. It is proposed that the MPC for insoluble Ra^{226} compounds be set at 5×10^{-11} $\mu c/cm^3$ for a 40-hr-week exposure. (C.H.)

20994 SOME REMARKS ON THE MAXIMUM PERMISSIBLE CONCENTRATION OF UNIDENTIFIED RADIONUCLIDES IN WATER AND RELATED DISPOSAL FORMULAE. H. Wyker (KEMA Nuclear Reactor Lab., Arnhem, Netherlands. Health Phys., 4: 309-11(1961).

A simplified system is presented for use in calculating maximum permissible concentrations of unidentified radionuclides in water. Several formulas used for similar calculations are discussed. (C.H.)

20995 SUGGESTED RADIATION PROTECTION REGULATIONS. DRAFT OF REVISION TO APPENDIX B, HANDBOOK 61. (National Bureau of Standards. National Committee on Radiation Protection, Washington, D. C.). Health Phys., 5: 1-19(1961).

Proposed revisions are presented for Appendix B, National Bureau of Standards Handbook 61 on the Regulation of Radiation Exposure by Legislative Means. Data are tabulated on the relative biological effects of various radiations, quantities of radioisotopes for sealed and unsealed sources which it is proposed to exempt from regulation, and values for permissible concentrations of radioisotopes in water and air above natural background. (C.H.)

20996 RADIATION DOSE ESTIMATION IN THE 1958 LOS ALAMOS CRITICALITY ACCIDENT. P. S. Harris (Los Alamos Scientific Lab., N. Mex.). Health Phys., 5: 37-44(1961).

An accidental radiation excursion occurring during Pu^{239} recovery operation resulted in significant exposure of three personnel, one exposure terminating in fatality. Irradiation of the fatally exposed person was nonuniform, and it was possible only to estimate his average body dose and dose incident to specific body areas. His average fast neutron dose was estimated as about 900 rads, and γ dose as 3000 to 4000 rads. The fast neutron doses incident to the head and upper abdomen were estimated as 2600 and 3000 rads, respectively, and the respective incident γ doses as about 7800 and 9000 rads. A second operator received a neutron dose estimated at 2.6 rads, and his film badge showed a γ of 118 rads. The third person's neutron and γ doses were estimated as 1.4 and 31.5 rads, respectively. Most of the γ dose to the nonfatality exposed operators was accumulated during subsequent trips near the source. (auth)

20997 ANALYSIS OF THE HAZARDS ASSOCIATED WITH RADIOACTIVE FALLOUT MATERIAL. I. ESTIMATION OF γ- AND β-DOSES. A. Broido and J. D. Teresi (Naval Radiological Defense Lab., San Francisco). Health Phys., 5: 63-9(1961).

An estimate of the contact β-dose-rate and the γ-dose-rate both at the surface and within the body due to radioactive fall-out contamination was made. The γ-dose-rate at external distances of from 0.01 to 30 cm from the contaminated body surface was estimated and correlated with the associated surface β-dose-rate. The surface-β-dose to an individual contaminated to the same extent per unit surface area as the surrounding field was compared to the γ dose at 1 m above the surrounding area. For the case in which there is one photon of 1 Mev energy per disintegration the surface β dose was found to be about forty times the γ dose at 1 m above the infinitely large contaminated field. (auth)

20998 THE HAZARD OF STRONTIUM-90. M. Powell. Irish J. Med. Sci. (6), No. 416, 363-73(Dec. 1960).

Strontium 90 effective half-life is 2.7×10^3 days. It emits beta rays and is selectively absorbed by bone. Strontium-90 is chemically allied to calcium and it moves with this element through the food chains and the foods which supply calcium to the body also supply strontium. In fact, exposure of the population occurs primarily by the contamination of dietary calcium by strontium-90. A study is made of the strontium-90-calcium ratio in the food chains and in the final deposition in the body. (auth)

20999 DISTRIBUTION OF SCATTERED X-RAYS IN AN X-RAY ROOM AND THE DOSE RECEIVED BY X-RAY WORKERS. M. Yoshizumi (Kurume Hospital, Japan). Iryo, 13: 511-22(1959).

Measurements were made during routine radiography, tomography, photoroentgenography, fluoroscopy, and deep therapy. The x-ray room was plastered by OSK paint to diminish reflection. The amount of scattered rays in every room was not negligible. The dose reached 50 mr when 20 subjects were photoroentgenographed or when 6 to 8 patients were examined by fluoroscopy. (auth)

21000 THE INTERNATIONAL CONFERENCE ON SAFETY OF LIFE AT SEA (1960). H. N. E. Whiteside (Ministry of Transport, Eng.). J. Joint Panel Nuclear Marine Propulsion, 5: No. 1, 36-41(Apr. 1961).

Recommendations and regulations are presented which are applicable to nuclear powered merchant ships. A nuclear ship is defined as any ship provided with a nuclear power plant. (C.H.)

21001 PERSONAL DOSIMETRY SERVICES OF DOSIMETRIC CENTER OF BOLOGNA. P. Amadesi (Università, Bologna), O. Rimondi, H. Sifaki, and M. Turtura. Minerva nucleare, 4: No. 11, 36p.(Nov. 1960). (CNEN-47). (In Italian)

A description is given of the types of film-badges used by the Centre of Personal Dosimetry of Bologna, the techniques adopted for the preparation and reading of films, the system of collecting data for statistical research, how the medical reports of the employees are maintained for any statistical research, and the mean values of the observations, for different kinds of radiations, during 1959. (EURATOM)

21002 CONSIDERATIONS AND STATISTICS ON THE DOSE ABSORBED BY PERSONNEL USING RADIOACTIVE SOURCES. L. Argiero (C.A.M.E.M., Leghorn). Minerva nucleare, 5: No. 1, 1-5(Jan. 1961). (In Italian)

The results of radiation dose control studies were presented. These involved workers exposed to x or gamma radiation, who were monitored by the Camen film badge service from May 1958 to June 1960. The amount of radiations received by each worker exceeded the maximum permissible dose only for workers exposed to x radiation. Their number, although still too high, is decreasing. (auth)

21003 DOSE CONSTANT OF RADIUM. B. Rajewsky and A. Sewkor (Max-Planck-Institut für Biophysik, Frankfurt am Main). Naturwissenschaften, 48: 216(1961). (In German)

The numerous absolute measurements of the dose constant of radium in equilibrium with its decay products show large variations and ranges of error. A new measurement was carried out using two ionization chambers. The dose output of a radiation source (298 mg Ra-El. with 0.5 mm Pt filters) was measured by the Townsend method in a free air space 26 m long, 24 m wide, and 22 m high. The attenuation coefficient of primary gamma radiation in air was first determined. After consideration of all corrections and the contribution of the scattered radiation, a value of 8.13 ±

$0.2\ r \times cm^2 \times hr^{-1} \times mg^{-1}$ was obtained. A calculated value, obtained using the latest absorption cross section and other physical data, of $8.30 \pm 5\%\ r \times cm^2 \times hr^{-1} \times mg^{-1}$ compares favorably with the experimental value. (J.S.R.)

21004 COBALT-60 DEPTH-DOSE CORRECTIONS AS DETERMINED BY TRANSMISSION-DOSE MEASUREMENTS. R. J. Schulz, G. A. Cohen, J. P. Tsai and J. C. Evans. (Yeshiva Univ., New York and Bronx Municipal Hospital Center, New York). Radiology 76: 805-9(May 1961).

A method for correcting the central-axis depth dose for tissue density variations is described. The only equipment needed is a Victoreen condenser r-meter and an inexpensive collimator of simple construction. The technic, which is based upon patient transmission, involves a transit dosimeter reading of radiation transmitted by the patient during the course of a routine treatment, a transit dosimeter reading made under identical conditions but with the patient removed, and the patient's anteroposterior diameter. With the aid of data presented above, which should be applicable to all cobalt teletherapy apparatus, the appropriate correction factors are readily obtained. (auth)

21005 STRONTIUM-90 AND CESIUM-137 IN NORTH AMERICAN MILK. J. L. Kulp (Lamont Geological Observatory, Palisades, N. Y.), A. R. Schulert, E. J. Hodges, E. C. Anderson, and W. H. Langham. Science, 133: 1768-70(June 2, 1961).

The Sr^{90} and Cs^{137} concentrations in powdered milk in North America vary roughly with the specific activity of rain. The Sr^{90}/Cs^{137} ratios in over 800 powdered milk samples taken from 60 stations from 1957 to 1960 have a standard deviation of only 44%. (auth)

21006 MEDICAL SUPERVISION IN RADIATION WORK. Second Report of the Expert Committee on Radiation. World Health Organization, Tech. Rep. Ser. No. 196: 1-31(1960). (A/AC-82/G/L. 561).

The principles for the control of health hazards associated with the constantly increasing applications of radiation and radioactive materials are similar to those applied for the safe use of other hazardous physical and chemical agents found in industry. Medical supervision is an essential element in the control program for radiation work. Preventive measures for the effective protection of workers exposed to radiation have been developed. A major problem is to inculcate an appreciation of the hazard and to disseminate the knowledge and skill for applying control procedures to keep pace with the expanding use of radiation. The scope of medical supervision, as with the other elements of the radiological health protection program, should be related to the specific character of the operation. Even though the medical procedures at present available cannot detect physical changes due to radiation until the amount of exposure has greatly exceeded the permissible dose levels, the preplacement and periodic medical examination program is an indispensable and final factor in evaluating the effect of such exposure on the health of the worker. The need for medical supervision in radiation work is related to the nature of the radiation hazard rather than to the number of individuals engaged. (auth)

21007 THE ATOMIC ENERGY COMMISSION AND REGULATING NUCLEAR FACILITIES. William H. Berman and Lee M. Hydeman. Ann Arbor, Michigan, University of Michigan, 1961. 346p.

The AEC has two fundamental responsibilities in connection with the conduct of private atomic energy activities. One is to assure that such activities are conducted so as not to subject workers or the public to undue risks from the hazards of ionizing radiation. In order to fulfill this responsibility, the AEC has established a comprehensive program for regulating the possession and use of source, byproduct, and special nuclear materials and the construction and operation of nuclear facilities. The other fundamental responsibility of the AEC is to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes. To this end, the AEC promotes progress in the civilian uses of atomic energy and has been directed by Congress to impose the minimum amount of regulation consistent with assuring health and safety. Much of the concern about the adequacy of the AEC's regulatory program relates to the fact that these functions of promoting and regulating atomic energy activities are thought to constitute inconsistent responsibilities. The regulatory program of the AEC is analyzed in the light of problems that have arisen. Recommendations are presented for certain changes in licensing systems. (C.H.)

21008 PROBLEMS OF DOSIMETRY OF NEW MODES OF RADIATION. Gerald J. Hine and Milton Friedman (Veterans Administration Hospital, Boston and New York University Hospital, New York). p.16-26 of "Proceedings [of] Conference on Research on the Radiotherapy of Cancer." New York, American Cancer Society, Inc., 1961.

Some of the dosimetric problems in clinical radiation therapy are discussed. Considerable progress has been made recently in defining and measuring the absorbed tumor dose. A particular tumor dose should be stated more comprehensively than by giving a single value, especially in the case of nonhomogeneous dose distributions. Fluorod measurements in phantoms and in patients under actual treatment conditions give useful information confirming and refining conventional tumor dose determinations. The biological effect of an absorbed tumor dose depends on a number of additional factors, such as relative biological effectiveness (RBE), treatment technique, fractionation, and patient response. At present, only very little information has become available concerning these variables. (auth)

21009 PROCEEDINGS [OF THE] THIRTEENTH INTERNATIONAL CONGRESS ON OCCUPATIONAL HEALTH, JULY 25-29, 1960. New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. 1005p.

This conference included sections on administrative practices, surgical practices, medical practices, education and training, environmental hygiene, social and legal aspects, influence of environmental factors on health, work physiology and psychology, and maximum allowable concentrations. Also, a section of general papers was included. Separate abstracts were prepared on 20 of the 256 papers presented. (L.T.W.)

21010 HEALTH AND SAFETY CONSIDERATIONS AT THE NUCLEAR POWER STATIONS OF THE CENTRAL ELECTRICITY GENERATING BOARD. C. A. Adams and J. A. Bonnell. p.93-8 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee on the Thirteenth International Congress on Occupational Health, 1961. (In English)

The Central Electricity Generating Board is responsible for the generation and high voltage transmission of electricity in England and Wales. Four nuclear power stations are under construction and plans for three additional stations are underway. Two of the stations are expected to go into operation during 1961. Proposals for the supervision of health and safety matters relating to nuclear power are outlined. (C.H.)

21011 PROBLEMS OF RADIOACTIVE INTERNAL DOSE EVALUATION. H. T. Daw (International Atomic Energy Agency, Vienna). p.106-10 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Problems connected with the estimation of radiation dose due to the incorporation of radioactive nuclides in the body are discussed. Monitoring methods and theoretical problems relating to the maximum allowable exposure from internally deposited radionuclides are reviewed. It is concluded that the present values recommended by the International Commission on Radiological Protection contain sufficient safety factors to make them acceptable in the present state of knowledge. (C.H.)

21012 THE NEED FOR ENVIRONMENTAL SURVEYS AROUND REACTOR STATIONS. H. J. Dunster (U.K.A.E.A. Atomic Energy Research Establishment). p.114-18 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

The purpose and form of preoperational environmental surveys of nuclear reactor sites are discussed. It is pointed out that preoperational surveys should be subsidiary to subsequent operational measurements. A method for use in a routine survey is outlined. (C.H.)

21013 RADIATION CONTROL OF NUCLEAR PLANTS AND ITS INFLUENCE ON THE COSTS OF THE PLANT. Carl-Eric Holmquist and David Sodergren. p.122-6 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Established standards for permissible levels of ionizing radiation for occupational exposure are discussed from the standpoint of cost of safety measures. Estimates for the direct cost of radiologic protection are compared with the costs for industrial hygiene activities. It is pointed out that many of the operational safety provisions required for a nuclear plant must be provided for reasons other than shielding or safety. It is not possible to arrive at definite figures for the cost of internal safety within a nuclear plant. Estimates are presented which are based on available information. (C.H.)

21014 SURVEYING FOR ENVIRONMENTAL RADIOACTIVITY — U. S. VIEW. G. Hoyt Whipple (Univ. of Michigan, Ann Arbor). p.171-8 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Whether for legal, liability, or moral reasons, some form of environmental survey is a contingent necessity for any nuclear facility with the potential of contaminating its environs with hazardous amounts of radioactivity. The scope of the survey will be influenced by the total amount of activity contained within the facility, the probability that any significant fraction of this activity may be released to environment, the nature of the surrounding area with regard to meteorology, hydrology, population density, agriculture and industry, and resources available to the facility. Approximately 0.1% of the capital cost of the facility should be set aside for the annual costs of the survey. The survey should be started at least 12 months before the facility is expected to go into operation, and a trained scientist should have primary responsibility for the survey. If the survey is not actually carried out by the responsible health agency, the results of the survey should be communicated to and discussed with this agency periodically. (auth)

21015 STATISTICAL ANALYSIS OF BERYLLIUM CONCENTRATIONS. William B. Harris (U. S. Atomic Energy Commission, New York). p.466-72 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Data gathered over an eight-year period at two reasonably well-controlled beryllium industrial plants indicate the possibility that the MPC as originally conceived may be somewhat more conservative than is necessary. The data presented represent approximately 5000 airdust samples which were collected by HASL for the analysis of beryllium concentration in the air. Moreover, these data are in close agreement with data gathered by the plant operator, whose total sample collection in that period was approximately 100,000. A substantial fraction of the individual samples exceeded 100 μg per cubic meter, and a significant number exceeded 500 μg per cubic meter. During most of this period no cases of acute beryllium disease developed nor have any chronic cases of beryllium poisoning been discovered after 10 years of plant operation. In the two plants the total number of employees covered by these data was of the order of 300 to 500 at any one time. The cumulative total plant population probably is of the order of 1000 to 2000. (auth)

21016 RADIATION FIELDS OF HIGH-ENERGY ACCELERATORS. Burton J. Moyer (Univ. of California, Berkley). p.519-22 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Problems of radiation safety in the vicinity of high-energy particle accelerators are associated primarily with shielding against high-energy neutrons and measurements of biological hazard. Methods of measuring radiation dose in a mixed neutron and gamma field are discussed. (C.H.)

21017 DANGERS RELATING TO DUSTS OF MINERALS IN URANIUM MINES. J. Pradel (Commissariat a l'Energie Atomique, Paris). p.522-31 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In French)

Hazards to persons working in uranium mines due to the inhalation of radioactive dusts are reviewed. Methods used in determining maximum permissible concentrations of radioactive dusts in air and methods for sampling air for the presence of radioactive dusts are considered. Equipment is described which has been used in France since 1959 for the effective control of dust hazards in uranium mines. (C.H.)

21018 THE IMPACT OF RADIOACTIVITY ON NATIONAL POLICIES RELATED TO PUBLIC HEALTH. Paul C. Tompkins (U. S. Naval Radiological Defense Lab., San Francisco). p.551-3 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

The keystone of any public health program concerned with radioactive materials is a determination of the range of acceptable risks. A determination of the environmental conditions that could lead to exposure within the acceptable range of risks can be made using techniques normally employed for industrial protection. It is pointed out that environmental radioactivity is not judged on the basis of the relative threats posed by the various sources taken separately, but by the total contributions from all sources in relation to the acceptable range of exposures as related to genetic injury and somatic risk. The principal isotopes that are of importance to environmental radioactivity are tabulated. (C.H.)

21019 RADIATION ACCIDENTS IN NUCLEAR TECHNOLOGY. Niel Wald and George E. Thoma. p.569-72 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Radiation accidents that have occurred during the past 15 years are reviewed. Thirty-seven individuals were involved in 7 major accidents, 5 of which occurred in the U. S. A. Clinical and laboratory findings are used to differentiate the patients falling into the various grades of clinical injury. Therapeutic procedures employed in the treatment of radiation injuries are outlined. (C.H.)

21020 RADIATION HAZARDS OF HIGH-ENERGY PARTICLE ACCELERATORS. B. M. Wheatley (European Organization for Nuclear Research, Geneva). p.585-7 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Problems associated with the control of radiation hazards from high-energy particle accelerators in research laboratories are discussed. Problems in radiation dose measurements and the control of radioactivity are reviewed. (C.H.)

21021 THE FUNCTION OF A RADIOISOTOPE COMMITTEE IN A LARGE RESEARCH ORGANIZATION. John D. Yoder (Esso Research and Engineering Co., Linden, N. J.). p.590-2 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

All work involving ionizing radiation is supervised by the Radioisotope Committee. The committee is composed of representatives from the Medical, Medical Research, and Safety Groups, and from the various operating divisions using radioisotopes. This committee is responsible for insuring that all work with ionizing radiation is carried out in a safe manner in compliance with existing federal and state laws. The Medical Division screens employees before allowing work with ionizing radiation and keeps a record of all employee exposures. External radiation exposures are monitored by film badges and direct-reading dosimeters. Internal exposures are monitored by analysis of body fluids or excrements. (auth)

21022 SEVEN-YEAR-EXPERIENCE SUMMARIES OF BERYLLIUM AIR POLLUTION IN A MODERN ALLOY FOUNDRY. John F. Zielinski (Brush Beryllium Co., Cleveland). p.592-60 of "Proceedings [of the] Thirteenth International Congress on Occupational Health." New York, U. S. Executive Committee of the Thirteenth International Congress on Occupational Health, 1961. (In English)

Results are reported from a survey on Be air pollution in a modern foundry producing Cu-Be alloy of 4.1 to 4.4% Be content. Over a 7-year period there was no evidence of chronic Be-induced disease. (C.H.)

21023 PROTECTION AGAINST RADIATION. A PRACTICAL HANDBOOK. John D. Abbatt, J. R. A. Lakey, and D. J. Mathias. Springfield, Ill., Charles C. Thomas, 1961. 243p.

Methods of radiation protection are discussed. Topics include the biological effects of radiation, the physics of radiation, natural background radiation, sources of radiation, medical care of radiation workers, radiation dosimetry and detection, maximum permissible doses of radiation, shielding, personnel protection, and the treatment of radiation injuries. (C.H.)

21024 RADIATION PROTECTION. RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ICRP PUBLICATION 3. REPORT OF COMMITTEE III ON PROTECTION AGAINST X-RAYS UP TO ENERGIES OF 3 MeV AND BETA- AND GAMMA-RAYS FROM SEALED SOURCES (1960). Published for The International Commission on Radiological Protection. New York, Pergamon Press, 1960. 88p.

Graphs, tables, and examples are appended from which the necessary numerical values for radiation protection may be obtained. (C.H.)

21025 VIEWS AND COMMENTS ON IMPROVING THE AEC REGULATORY PROCESS, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, JUNE 1961. (United States. Congress. Joint Committee on Atomic Energy). 98p.

Leaders in the atomic energy industry and a number of law school professors with experience in the area of administrative law were asked for comments on proposed changes in AEC regulatory procedures. These views and comments are presented. (C.H.)

21026 DETECTION AND IDENTIFICATION OF RADIOACTIVE ELEMENTS IN GEOPHYSICAL PROSPECTION. J. Guitton and C. Lallemant (to C. E. A.). Belgian Patent 589,350. Priority date, Apr. 10, 1959.

The device is used mainly for aerial prospection and shows the existence of thorium or uranium bearing deposits. The discrimination is effected by means of Schmitt-type flip-flop circuits taking into account that the characteristic energy peaks for gamma rays emitted by thorium are between 0.7 and 1.05 Mev, and by uranium, between 1 and 2 Mev approximately. A recording instrument gives two graphs, one showing the total gamma activity the other showing positive peaks for the activity due to uranium and negative peaks for the activity due to thorium deposits. The equipment used, scintillator, photomultiplier, amplifiers, etc...., is commercially available. (EURATOM)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

?1027 (CEA-1809) L'EMPLOI DE SOURCES RADIO-ACTIVES POUR L'ETUDE DE L'USURE DES REVETE-MENTS REFRACTAIRES. (The Use of Radioactive Sources for the Study of Wear in Refractory Linings). G. Courtois and R. Hours (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleairs, Saclay). 1960. 13p.

Following a discussion on the radioactive method for studying wear in refractory linings, advantages and disadvantages, choice of radioactive indicator, and detection, problems of safety involved in the technique are dealt with. The two most important points discussed are: the need to fix an upper limit of activity in the cast iron; and the precautions necessary to remedy the diffusion of cobalt-60 in the brick-work. After a discussion on the international view point regarding the use of the method, a brief outline of some French projects is given, with particular reference to the case of a blast furnace. A note from the Commission interministérielle des Radioéléments is given as an appendix which deals with special conditions laid down for the use of radioelements in the determination of wear in refractory walls. (auth)

?1028 (CEA-tr-X-230) L'UTILISATION DE PARA-TONNERRES RADIOACTIFS PERMET UNE MEILLEURE PROTECTION CONTRE LES COUPS DE FOUDRE. (Use of Radioactive Lightning Rods for Better Protection Against Lightning Bolts). J. Van der Klis. Translated into French from Electronica, 12: 165-7, 171(1959). 19p.

The phenomenon of lightning is discussed, and a radioactive lightning-rod is described. The radiation causes a silent discharge which neutralizes the cloud-earth potential. How the particular configuration of the rod extends its effectiveness over a wider area is shown. (T.R.H.)

?1029 (JPRS-9163) THE USE OF IONIZING RADIATIONS FOR THE STERILIZATION OF MEDICINAL PREPARATIONS. Z. V. Ermol'eva (Yermol'yeva) and V. I. Pochapinskii (Pochapinskiy). Translated from Med. Prom., 15: No. 1, 33-8(Jan. 1961). 11p.

A review of data on the utilization of ionizing radiation for the sterilization of medicinal preparations is presented. In this sterilization method gamma radiation from Co^{60}, Cs^{137}, and other radioisotopes and accelerated electrons at 2 to 6 Mev are used. Tables are shown of the effect of irradiation on the specific activity of certain antibiotic preparations. Testing of irradiated preparations for stability of preservation demonstrated that irradiated preparations of penicillin, streptomycin, terramycin, and complex vitamin preparations retain their activity as well as the non-irradiated ones. (M.C.G.)

?1030 UTILIZATION OF RADIOACTIVE ISOTOPES IN CONSTRUCTION. STUDY OF THE ORIGIN OF HUMIDITY IN A BUILDING AND OF LEAKS IN A DRAIN. D. J. M. Camboa Loyarte, D. M. Del Val Cob, D. A. Plata Bedmar, and D. S. Norena De La Camara. Energia nuclear (Madrid), 5: No. 17, 57-65(Jan.-Mar. 1961). (In Spanish)

The techniques used in determining the origin of the humidity in the chemistry building of the Juan Vigon Nuclear Center and the drain leaks in the system are described, and the results obtained are reported. (J.S.R.)

21031 TREATMENT OF MEATS WITH IONISING RADIATIONS. VI. CHANGES IN QUALITY DURING STORAGE OF STERILISED RAW BEEF AND PORK. B. Coleby, M. Ingram, and H. J. Shepherd (Low Temperature Research Station, Cambridge, Eng.). J. Sci. Food Agr., 12: 417-24(May 1961).

Radiation-sterilized raw beef and pork were stored at temperatures from −20° to +37°, and changes in appearance, odor, texture, and flavor, during several months, were assessed by a panel using ranking and hedonic scores. The changes in appearance were deleterious, but of minor importance save at the highest temperatures. There was a softening of texture and loss of fluid, presumed due to autolytic changes, also greater at the higher temperatures; but, even after several months at 37°, the fibrous texture of the meat remained intact during cooking. The initial irradiation odor and flavor gradually changed to stale and bitter flavors and, though there were minor fluctuations, the general trend was a marked deterioration, again more rapid the higher the temperature. Meat irradiated with 5 Mrads at −75° was preferred to that with 2 Mrads at 18°, confirming the protective effect of freezing; but, on storage under similar conditions, the former deteriorated like the latter. Occasional samples, in both series, were not sterilized. It is concluded that for the radiation-preservation of raw meat at normal temperatures, the storage changes represent as serious an obstacle as the initial effect of irradiation. (auth)

21032 APPLICATION OF INTRINSIC RADIOTRACERS TO THE REMOVAL OF IMPURITIES FROM INDUSTRIAL PROCESS STREAMS. J. L. McFarling, P. Gluck, J. F. Kircher, and D. N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Nuclear Soc., 4: No. 1, 124-5(June 1961).

21033 RADIOACTIVE TRACER METHOD FOR EVALUATING AND CONTROLLING ALUMINUM CLEANERS. M. Levine (Lockheed Aircraft Corp., Burbank, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 128-9(June 1961).

21034 GAMMA-RAY DENSITY METERS: ANALYSIS AND DESIGN DATA. R. A. Semmler, F. F. Rieke, and J. E. Brugger (Univ. of Chicago). Trans. Am. Nuclear Soc., 4: No. 1, 129(June 1961).

21035 VII RASSEGNA INTERNAZIONALE ELETTRONICA E NUCLEARE. V CONGRESSO NUCLEARE 1960. VOLUME SECONDO. (VII International Electronic and Nuclear Review. V Nuclear Congress. Volume 2). Rome, Comitato Nazionale Ricerche Nucleari, [1960]. 495p.

Twenty-six papers on the characteristics and preparation of radioisotopes for medical and industrial utilization are compiled. Separate abstracts have been prepared for five. (J.S.R.)

ISOTOPE SEPARATION

21036 (MLM-1104) ISOTOPE SEPARATION BY THERMAL DIFFUSION: SHAPE FACTORS FOR THE EXTREME CYLINDRICAL CASE. M. L. Curtis, Vija Wurstner, and G. R. Grove (Mound Lab., Miamisburg, Ohio). July 15, 1960. Contract AT(33-1)-GEN-53. 20p.

Work was completed in computing tables of shape factors for the cylindrical case used in determining the transport coefficients of thermal diffusion columns for isotope separation. The shape factors are tabulated in terms of the radii and temperature ratios of hot and cold walls of thermal diffusion columns for values of n equal to 1.0, 0.8, and 0.6. (auth)

21037 (AEC-tr-4634) SEPARATION OF BORON ISOTOPES USING CHEMICAL EXCHANGE. II. COMPLEX BORON TRIFLUORIDE COMPOUNDS WITH β, β'DICHLORODIETHYL ETHER (CHLOREX). V. M. Panchenkov, A. V. Makarov, and L. I. Pechalin. Translated by Al Monks (Oak Ridge National Lab.) from Zhur. Fiz. Khim., 34: 2489-94(1960). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 7667.

21038 (AEC-tr-4644) A CHEMICAL METHOD FOR THE SEPARATION OF BORON ISOTOPES. G. M. Panchenkov, V. D. Moiseev, and A. V. Makarov. Translated by Al Monks (Oak Ridge National Lab., Tenn.) from Zhur. Fiz. Khim., 31: 1851-60(1957). 14p.

This paper was previously abstracted from the original language and appears in NSA, Volume 12, abstract no. 392.

21039 THE ISOTOPIC SEPARATION OF CARBON BY ION EXCHANGE. Charles N. Davidson, Charles K. Mann, and Raymond K. Sheline (Florida State Univ., Tallahassee). J. Am. Chem. Soc., 83: 2389-90(May 20, 1961).

An efficient and rapid process for the fractionation of the isotopes of carbon using the system hydroxide-hydrogen cyanide-hydrogen chloride on the strongly basic resin, Dowex 2, is described. Self-sharpening boundaries are obtained at both ends of the cyanide band, permitting it to be passed through an extended length of resin bed without appreciable dispersion. The carbon-14 is determined by measuring the specific activity of the carbon-14 enriched cyanide in the total amount of HCN solution. Graphical data are presented on the carbon-14 separation. (N.W.R.)

21040 ACTUAL METHODS FOR THE ENRICHMENT OF URANIUM-235. Marten Martensson. Tek. Tidskr., 89: 487-93(1959). (In Swedish)

A review of methods for the enrichment of U^{235} is presented. The separation processes discussed are gaseous diffusion, effusion through a nozzle, and gas centrifugation. Equipment diagrams and principles of operation are included. (N.W.R.)

21041 SEPARATION OF BORON ISOTOPES BY THE METHOD OF CHEMICAL EXCHANGE. G. M. Panchenkov, A. V. Makarov, and L. I. Pechalin. Vestnik Moskov. Univ., Ser. II, No. 2, 3-12(1960). (In Russian)

Boron isotopes were separated through the interaction between boron tetrafluoride and the boron tetrafluoride anisole complex. In this method, B^{10} is enriched in the liquid phase. The dependence of the separation coefficient on temperature and the flow velocity of the complex were studied. The best separation coefficient obtained was 1.607. Other complex compounds, boron tetrafluoride with phenetole, β,β'-dichlorodiethyl ester, etc., are suggested for the separation of boron isotopes by the exchange method. (auth)

21042 SEPARATION OF ISOTOPES, MAINLY LITHIUM ISOTOPES. (to Société Ugine). Belgian Patent 552,673. Oct. 15, 1956.

An electric potential is periodically applied to a lithium-bearing solution, the cathode being constituted by a vertical flow of mercury. The ions of lithium-6 are preferably deposited on the mercury cathode, and a slight enrichment of this isotope is observed in the continuously tapped amalgam. (EURATOM)

21043 PRODUCTION OF DEUTERIUM AND OF ITS COMPOUNDS, AND OF OTHER LIGHT ISOTOPES. P. Maldague. Belgian Patent 581,198. Priority date, Aug. 4, 1958.

The process is based on the spectrometric resonance of hydrogeneous molecules. By submitting compounds such as halogen hydrides to a selected monochromatic radiation, HX molecules remain unaltered whereas DX molecules are dissociated into deuterium and halogen. Adequate pressure and temperature values increase the yield of the reaction which can also apply to other light isotopes such as lithium, beryllium, and boron. (EURATOM)

21044 PROCESS FOR DEUTERIUM ENRICHMENT OF WATER OR HYDROGEN. (to DEGUSSA). Belgian Patent 589,902. Priority date, Apr. 24, 1959.

Two columns are used to obtain catalytic deuterium enrichment of water or hydrogen by isotopic exchange. The first is liquid counterflow at 27 to 52°C and the second is parallel gas flow at 477 to 527°C. The catalyst, an aqueous suspension of Pt or Ni, is periodically regenerated. Deuterium recovery is claimed to reach 60%. (EURATOM)

21045 PROCESS FOR THE CONCENTRATION OF HEAVY WATER. (to Norsk Hydro-Elektrisk Kvaelstofaktieselskab). British Patent 867,736. May 10, 1961.

An improved process for the concentration of heavy water which is particularly adapted for use in conjunction with an ammonia synthesis plant is described. Deuterium is extracted from hydrogen gas derived from the decomposition of water by catalytic exchange with ammonia. The ammonia thus enriched with deuterium is brought to isotopic exchange with water. The ammonia removed from the water is decomposed to nitrogen and hydrogen. This gas mixture is recirculated to the hydrogen exchange unit, and all the deuterium-enriched water derived from the ammonia–water exchange system is returned to the water-decomposition plant. A modification of the process consists in decomposing part of the enriched ammonia discharged from the ammonia–hydrogen exchange step in an extra decomposer unit and at once conveying this gas mixture back to the exchange step. (N.W.R.)

21046 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE PRODUCTION OF DEUTERIUM-ENRICHED HYDROGEN. William Havelock Denton (to United Kingdom Atomic Energy Authority). British Patent 869,412. May 31, 1961.

An apparatus for the production of deuterium-enriched hydrogen is described. The apparatus has low power consumption and is fed with impure hydrogen. The unit consists of a distillation column, a feed heat exchanger in which the hydrogen feed to the distillation column passes countercurrently to deuterium-depleted hydrogen leaving the distillation column, and a refrigeration circuit. The refrigeration circuit consists of at least three heat exchangers in which deuterium-depleted hydrogen from the

distillation column passes countercurrently to deuterium-depleted hydrogen returning to the distillation column and at least two expansion turbines connected between the heat exchangers in the return side of the circuit. The unit also has means whereby a fraction of the deuterium-depleted hydrogen leaving the distillation column and passing countercurrently to the hydrogen feed to the distillation column in the feed heat exchanger is fed to the hottest point of the refrigeration circuit. The feed heat exchanger is provided with flow reversing means for purification of the feed below 50°K at the pressure of the distillation column. (N.W.R.)

21047 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF DEUTERIUM-ENRICHED COMPOUNDS. Henry Reginald Clive Pratt (to United Kingdom Atomic Energy Authority). British Patent 869,413. May 31, 1961.

A hydrogen isotope exchange process for the production of deuterium-enriched hydrogen, water, ammonia, or other hydrogen-containing compound is described. The process consists of operating a dual-temperature hydrogen isotope exchange process to produce deuterium-enriched compounds relative to the feed of the exchange process, subjecting the water, hydrogen, or ammonia to further enrichment by a distillation process, and recycling the deuterium-depleted waste from the distillation process to the dual-temperature exchange process. From the enriched hydrogen products obtained, heavy water may be obtained by converting the products by known processes. (N.W.R.)

21048 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE PRODUCTION OF HEAVY WATER. Henry Reginald Clive Pratt and Douglas Handley (to United Kingdom Atomic Energy Authority). British Patent 869,414. May 31, 1961.

A dual-temperature plant for producing deuterium-enriched hydrogen or water is described. The plant comprises the combination of a single exchange tower consisting of alternate water–water vapor countercurrent contacting sections and vapor-phase water–hydrogen isotope exchange catalyst beds operated at one temperature, and a plurality of steam–hydrogen isotope exchange catalyst beds operated at a higher temperature and water–water vapor countercurrent contacting columns so arranged that water passes consecutively through the contacting columns while hydrogen and water vapors pass alternately through the contacting columns countercurrently to the water and through the steam-hydrogen exchange catalyst beds. The exchange plant is connected to a hydrogen distillation plant for producing hydrogen which is further enriched in deuterium, and a further conduit is provided for recycling the deuterium-depleted hydrogen from the distillation plant to the exchange plant. Means are provided for hydrogen isotope exchange between the deuterium-depleted hydrogen and water of natural deuterium concentration before the deuterium-depleted hydrogen is recycled to the exchange plant. (N.W.R.)

21049 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF DEUTERIUM-ENRICHED HYDROGEN. William Havelock Denton and Douglas Handley (to United Kingdom Atomic Energy Authority). British Patent 869,415. May 31, 1961.

A process for the production of deuterium-enriched hydrogen is described. The process comprises the steps of supplying water of natural deuterium concentration to a dual-temperature water-hydrogen isotope exchange process to produce hydrogen enriched in deuterium above natural deuterium concentration by a factor of about 1.5. The enriched-hydrogen is subjected to further enrichment by a distillation process, and the deuterium-depleted hydrogen is recycled from the distillation process to the dual-temperature exchange process through a high temperature deuterium transfer apparatus in which the depleted hydrogen is equilibrated with water of natural deuterium concentration. (N.W.R.)

21050 IMPROVEMENTS IN METHODS OF ISOTOPE CONCENTRATION. (to Commissariat a l'Energie Atomique). British Patent 870,036. June 7, 1961.

A process for preparing heavy water is described. The water is enriched in deuterium by exchange of deuterium between water and hydrogen sulfide in different phases of a cascade system of interconnected stages. The stages consist of two exchange columns at different temperatures which flow countercurrently and intermingle so that the water is enriched in one column and impoverished in the other. The process is characterized in that a proportion of the hydrogen sulfide flowing through each stage except the last is withdrawn between the columns and passed to the impoverishing column of the next succeeding stage; the hydrogen sulfide flowing from the enriching column of each stage except the first is returned to the enriching column of the next preceding stage and the hydrogen sulfide from the enriching column of the first stage is recycled to the impoverishing column of that stage. A modification is also described in which a portion of the hydrogen sulfide is flowed through each stage except the last two stages. In these stages the H_2S is withdrawn between the columns and is passed to the impoverishing column of the next. The hydrogen sulfide flowing from the enriching column of each stage except the first two stages is returned to the enriching column of the next. The hydrogen sulfide from the enriching columns of the first two stages is recycled to the impoverishing columns of these stages. (N.W.R.)

21051 PROCESS FOR CONCENTRATING HEAVY HYDROGEN. Hugo Fellner-Feldegg (to Farbwerke Hoechst A. G.). Canadian Patent 613,201. Jan. 24, 1961.

A process for the concentration of heavy hydrogen by distillation of liquid hydrogen is described. The process consists of heating hydrogen, which is poor in heavy hydrogen and which is distilled between −220 and −260°C, to a temperature between 0 and 700°C and compressing it to a pressure of 1 to 200 atmospheres. The heated hydrogen is then brought into contact with hydrogen-containing compounds having a concentration of heavy hydrogen between 80 and 200 parts per million by volume so as to produce an isotope exchange. The hydrogen-containing compounds are separated while cooling the hydrogen enriched with heavy hydrogen to between −200 and −260°C. The pressure is released and the enriched hydrogen is refluxed into the distillation process. (N.W.R.)

21052 CENTRIFUGES. Karl P. Cohen (to Atomic Energy of Canada, Ltd.). Canadian Patent 615,723. Mar. 7, 1961.

A centrifuge and method for separating gases or vapors with molecular weights greater than 250 are described. The design equations for the centrifugal isotope separation of mixtures of the uranium hexafluoride vapors $U^{235}F_6$ and $U^{238}F_6$ and for other gaseous mixtures are presented. The centrifuge is designed to produce a maximum of separative work per unit length of the centrifuge chamber and is characterized by its substantial equilibrium in operation. The centrifuge employed is the continuous flow-through type wherein the centrifuge chamber is rotatably supported by means of tubular shafts arranged coaxially of the vertically disposed rotational axis of the chamber at opposite ends. These tubular shafts serve also as the inlet and outlet,

respectively, to and from the centrifuge chamber and the shaft at the upper end of the chamber is employed as a single inlet. The shaft at the lower end of the chamber is divided to provide two parallel or concentric outlet passages for the heavier and lighter separations. (N.W.R.)

21053 METHOD FOR COOLING A CIRCULATING GAS IN A PLANT FOR ENRICHMENT OF HEAVY WATER. Bengt Eriksson (to Allmänna Svenska Elektriska AB). Canadian Patent 616,048. Mar. 7, 1961.

A method for cooling a gas which circulates through a heavy water enrichment plant is described. The plant is of the type where the isotope exchange occurs between the gas and water at two different temperatures. There are at least two vessels in which the exchange reaction takes place, one warm and one cold. The method consists of cooling the gas before it is introduced into the cold vessel by bringing it in counter-current direct contact with a stream of water substantially saturated with a gas of the same kind as that circulating in the system. The stream of water is cooled in the presence of added gas of the same kind as that circulating in the system by leading the stream of water away from the counter-current direct contact with the gas circulating in the system, supplying the stream of water with added gas, cooling the stream of water in the presence of the added gas, and bringing the stream of water in repeated counter-current direct contact with the gas circulating. (N.W.R.)

21054 PROCESS FOR OBTAINING WATER OR HYDROGEN ENRICHED BY DEUTERIUM. Erwin W. A. Becker. Canadian Patent 616,561. Mar. 21, 1961.

A process for the production of hydrogen or water having an increased deuterium content is presented. The process consists of passing hydrogen and liquid water in counter-current in deuterium-exchanging relation in the presence of a catalyst under increased pressure through two columns each maintained at a different temperature. The temperature of the two columns are 20 to 50°C for the first and about 200°C for the other; the pressure increase being about 100 atm. A description of the equipment is presented along with the flow pattern and chemicals used in the process. (N.W.R.)

MATHEMATICS AND COMPUTERS

21055 (BRL-Memo-1135) A NEW MONTE CARLO METHOD FOR SOLVING NEUTRON AND GAMMA RAY TRANSPORT PROBLEMS. Frank J. Allen (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Apr. 1958. 33p.

A method for solving neutron and gamma transport problems was developed and compared in efficiency with the standard Monte Carlo method. An idealized transport equation for which there exists a simple analytic solution was used to effect the comparison. It is shown that the proposed method is more efficient than the standard Monte Carlo method because no biased sampling techniques are used. (auth)

21056 (HW-67305) A STATISTICAL METHOD TO CALCULATE THE JOINT CONFIDENCE ESTIMATES FOR THE INDIVIDUAL ISOTOPES OF A MULTIPLE GAMMA-RAY SPECTRUM. R. L. Buschbom and W. L. Nicholson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 3, 1960. Contract AT(45-1)-1350. 28p.

A method of calculating the joint confidence estimates for the individual isotopes of a multiple gamma spectrum of an unknown sample was developed. The data available to base this confidence estimate on are a qualitative resolution of the unknown spectrum, the total number of counts in each region of the spectrum, and the counting time for each spectrum. Examples were examined to illustrate how the eccentricity and the orientation of the joint confidence region affects the precision of the estimate of the joint confidence region by the marginal region. The effects of the magnitude of the coefficient of errors and the percent of overlap of the isotopes on the confidence region were determined. (M.C.G.)

21057 (NAA-SR-6192) FORTRAN PROGRAMS FOR CRYSTAL SPACINGS. G. M. Wolten (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 1, 1961. Contract AT(11-1)-GEN-8. 44p.

Nine FORTRAN digital computer programs for calculating interplanar spacings in each of the six (or seven, depending on the point of view) crystal systems are presented and discussed. (auth)

21058 (NP-9650) A DIGITAL COMPUTER REPRESENTATION OF THE LINEAR, CONSTANT-PARAMETER ELECTRIC NETWORK. Technical Memo. No. 8436-TM-3. Charles Shelly Meyer (Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.). Aug. 1960. Contract AF-33(600)-40604. 106p.

A digital computer routine resulting in a set of equations that can be solved for the branch currents or branch voltages of a linear, constant-parameter electric network is described. Topological relations are defined, and a matrix equilibrium equation, based on these relations, forms the desired representation. Advantages are obtained from the unique branch numbering system which affords the circuit analyst the opportunity of specifying tree or link branches. Other existing computer routines are studied, and a comparison is made with the method of this research. Detailed flow charts are presented, and a sample circuit is analyzed. This work, done as a thesis, is reported as part of a study program in computer-aided design. Although the major emphasis of the study is on design of mechanical parts to be made by numerically controlled manufacturing, the study of computer methods for design of electrical networks is also pertinent. (auth)

21059 (P-1806(RAND)) PARAMETER-FREE AND NONPARAMETRIC TOLERANCE LIMITS: THE EXPONENTIAL CASE. Leo A. Goodman (Chicago. Univ.) and Albert Madansky (RAND Corp., Santa Monica, Calif.). Sept. 18, 1959. Revised Mar. 25, 1960. 41p.

Exact parameter-free tolerance intervals based on the first r ordered observations from a sample of size n from an exponential distribution are developed. Various criteria for goodness of tolerance intervals are examined, and certain optimum properties of the intervals are demonstrated. The asymptotic behavior of the intervals is studied. Comparisons are made between the intervals and non-parametric tolerance intervals. The effect of assuming an exponential distribution, when in fact the distribution is a mixture of two exponentials, is discussed. (auth)

21060 (TID-12639) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. DATA REDUCTION METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Jan. 1961. 46p.

The number of transistors required in various arithmetic control sections are listed. Measurements of transient base currents with very fast rising or falling signals are reported, and transistor behavior at very low impedance levels was studied. A Wiener functional integral was evaluated numerically. New routines, new problems, and error analyses are described for Illiac and IBM-650. (D.L.C.)

21061 (WAPD-TM-216) BAND-1—A DATA REDUCTION PROGRAM FOR THE IBM-704. B. L. Anderson, A. P. Hemphill, P. H. Jarvis, and R. E. Kettler (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1961. Contract AT-11-1-GEN-14. 50p.

BAND-1 is an IBM-704 program to reduce the experimental data obtained from measurements of the neutron activation distribution within a critical facility. The data reduction consists of correcting the measured data, sorting and ordering it, and calculating the critical buckling parameters by means of a least squares analysis. (auth)

21062 THE PADÉ APPROXIMANT. George A. Baker, Jr. and J. L. Gammel (Los Alamos Scientific Lab., N. Mex.). J. Math. Anal. and Appls., 1: No. 2, 21-30(Feb. 1961).

A method in which the Padé approximant is used to calculate the asymptotic behavior of a function from the first few terms of its power series is presented. This method is illustrated by two examples and a partial justification is given. One of the examples is a calculation of the binding energy of a Fermi gas of hard spheres. The other is the calculation of the scattering length of a hard core potential. (N.W.R.)

21063 ON DEFLATING MATRICES. A. S. Householder (Oak Ridge National Lab., Tenn.). J. Soc. Ind. Appl. Math., 9: No. 1, 89-93(Mar. 1961).

The reduction of a matrix which has several roots is treated. For example, when a characteristic root of a matrix A of order n is known, it is possible, by any of sev-

eral known methods, to replace A by a matrix B, n-1 of whose roots are the yet unknown roots of A, and such that either B is of order n−1, or else its remaining root is zero. It is shown that the vector iterates approach an invariant subspace belonging to these roots, and even when the roots are close, the corresponding invariant subspace is more stably separable from the complementary invariant subspace than are the principal vectors from one another within the subspace. By repeated application of the equations listed, the invariant subspaces can be peeled off and the problem reduced, at each step, to one of lower order. (N.W.R.)

21064 GENERATION OF PERMUTATIONS BY TRANSPOSITION. Mark B. Wells (Los Alamos Scientific Lab., N. Mex.). Math. of Computation, 15: No. 74, 192-5(Apr. 1961).

Many problems require the generation of all n! permutations of n marks (called arrangements). A generation scheme is presented whereby each step consists of merely transposing two of the marks. The bookkeeping is quite simple, thus this scheme is somewhat faster than either the usual dictionary-order method or the Tompkins-Paige method. The important property of leaving the (j + 1)st position alone until all j! arrangements of the marks in the first j positions have been generated is preserved. (auth)

21065 SEA LION—A TIME-DEPENDENT APPROXIMATE AERO-THERMODYNAMIC CODE TO CALCULATE AXIAL TEMPERATURE DISTRIBUTIONS OF MULTIPLE CONDUITS. R. E. Var and P. M. Uthe, Jr. (Univ. of California, Livermore). Trans. Am. Nuclear Soc., 4: No. 1, 12-13(June 1961).

21066 A UNIFIED APPROACH TO MONTE CARLO METHODS. J. Spanier (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 81-2(June 1961).

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

21067 (AD-239305) RESEARCH IN PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES. Semiannual Progress Report, June 30, 1960. Robert Lowrie (Union Carbide Nuclear Co. Research Center, Tuxedo, N. Y. and Union Carbide Corp. Parma Research Lab., Ohio). Contract DA-30-069-ORD-2787. 61p.

The behavior of refractory materials in high temperature environments is being investigated in order to establish good working data and general principles. The areas of interest include thermal and mechanical properties, and mechanisms of loss of material at the surface by evaporative processes or by reaction with free-radial species. Studies of the nature of species arising directly from a solid surface by evaporation are being pursued utilizing three independent techniques. Applicability of the matrix-isolation technique was demonstrated, and in the cases of boric oxide and carbon evidence was obtained for the presence of B_2O_3 and C_3 in the respective vapors. A newly built wide-range mass spectrometer of high resolving power was brought into service. Incidental to this, measurements of the heat of vaporization of palladium were made giving an approximate value of 93 kcal per mole. The third approach for determining vapor species is by emission spectroscopy for which a furnace capable of operation at 3000°C is practically complete. Work was done on reactions of nitrogen and hydrogen atoms with solid surfaces. It was found that with nitrogen atoms and carbon an appreciable reaction occurs when carbon is heated up to the vicinity of 1350°C. With hydrogen atoms and carbon on the other hand, reaction takes place at about room temperature. Techniques are being improved in order to obtain quantitative data leading to an understanding of the kinetics and mechanisms involved. Investigations of the thermal properties of solids at high temperatures gave substantial results. Thermal conductivity data were obtained using an improved version of the Longmire technique for carbon, graphite, and several refractory metals including titanium and zirconium. An extension of this method using transient heating to measure the specific heats of solids was also developed, and work with graphite established the validity of the technique. A new technique of determining conductivity using periodic heating of a wire sample was devised. The equipment for applying it, particularly to single-crystal samples, is nearly completed. A theoretical study has revealed a method capable in principle of simultaneously determining the thermal conductivity and specific heat of a sample at high temperatures. Data on the spectral emissivities of certain single crystals were obtained at 725 to 2125°C. Values for the two extremes of temperature respectively are: titanium carbide—0.40 and 0.32, titanium diboride—0.26 and 0.24, niobium carbide—0.28 and 0.22. Work toward the measurement of other physical properties at very high temperatures was largely on the design and construction of equipment and the preparation of materials for specimens. A furnace and testing fixtures were constructed for bending single crystals at elevated temperatures, and work is proceeding on the production of high-purity MgO crystals, for which the highest grade carbon electrodes were found necessary. Another furnace is being constructed for conducting tensile and creep tests on refractory compounds at temperatures up to 2700°C, and a pulse-echo technique is being developed for measuring elastic properties at high temperatures. An additional special furnace was designed and is being built to permit x ray measurements on specimens at high temperatures, and some x ray studies were also undertaken at room temperature to help characterize refractory compounds which were produced as specimen materials. (auth)

21068 (AD-246722) RESEARCH ON THE PRODUCTION OF ULTRA PURE REFRACTORY METALS. Final Report, July 1, 1959 thru June 30, 1960. (Alloyd Corp., Cambridge, Mass.). Sept. 27, 1960. Contract NOas 59-6248-c. 35p.

Molybdenum, tantalum, and tungsten metals were prepared by hydrogen reduction of purified chloride vapors. The chlorides were purified by combinations of low-pressure distillation and multi-pass zone refining. It was found that with chloride vaporization temperatures of 150 to 250°C, reduction temperatures of 800 to 950°C, total pressure during reduction of 15 cm. Hg or less, and H_2: chloride mole ratios of 5 to 20 : 1 satisfactory deposits of coherent, fully dense metal are obtained. Molybdenum samples up to 60 gm. in weight, deposited at up to 8.9 gm/hr were produced. Similar data for tungsten are 177 gm. in weight, with a maximum deposition rate of 18.7 gm/hr. Comparable data for tantalum were not available. The metallic impurity contents of the metals were quite low, ranging from 10 to 100 ppm for molybdenum, 30 to 2500 ppm for tungsten, and 30 to 200 ppm for tantalum. Gaseous impurities generally totaled less than 10 ppm. The preparation of very pure chromium metal through the reversible reaction $Cr + ZnCl_2 \rightleftharpoons CrCl_2 + Zn$ was attempted, but was not successful. (auth)

21069 (BM-RI-5795) ELECTROWINNING MOLYBDENUM: PRELIMINARY STUDIES. H. J. Heinen and J. B. Zadra (Bureau of Mines. Reno Metallurgical Research Center, Nev.). July 1960. 8p.

A summary of preliminary research is presented on electrowinning Mo directly from pure or impure Mo trioxide (MoO_3) by fused-bath electrolysis in an open graphite cell without need of a protective inert atmosphere. A formulated electrolyte of the tertiary system containing 41.6% sodium pyrophosphate, 16.7% sodium tetraborate, 33.3% sodium chloride, and 8.4% molybdenum trioxide, by weight, electrolyzed at 1000°C, gave excellent results. Current density studies were made over a range from 20 to 260 amperes per square decimeter. Current efficiencies of 80 to 90% were obtained over the entire range. Yields up to 500 grams of Mo per kilowatt-hour were obtained. Higher current densities, however, reduced yields and produced a finer grained metal. The two most important facets in electrowinning molybdenum from MoO_3, in an open cell, are temperature and electrode spacing to minimize or eliminate the formation of the suboxide MoO_2, the major source of oxygen contamination. At temperatures of 1000°C and higher, together with the proper spacing of the electrodes, formation of oxides are practically eliminated. (auth)

21070 (NP-10183) THEORY OF DISLOCATION MOBILITY IN PURE SLIP. Jens Lothe (Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab.). [1961]. Contract Nonr 760(08). 43p.

The mobility during glide of uniformly moving dislocations or dislocation segments supposed not to be obstructed by any Peierl's barrier is estimated. It is shown that the energy

dissipation associated with the strong anharmonicities in the core misfit plane is negligible. For a straight freely moving dislocation, the thermoelastic and the phonon viscosity effect give rise to a drag stress at ordinary temperatures $T \sim \theta$, θ being the Debye temperature, of the order $\sigma \sim (1/10)\ \epsilon \times (V/C)$ in insulators. In metals the thermoelastic effect is negligible, while the phonon viscosity effect will be of the same order of magnitude as in insulators. In the formula, ϵ = thermal energy density, V = dislocation velocity, and C = velocity of shear waves. The scattering of phonons by the dislocation causes a drag stress at ordinary temperatures of the order of magnitude of the above formula. All of the contributions to the drag stress go rapidly to zero with decreasing temperature. However, if the dislocation is constrained by the Peierl's barrier except at freely moving kinks, the kink mobility determines the dislocation mobility. It is shown that the scattering of phonons of a half-wave length larger than the kink width causes a drag stress outweighing all other contributions, and which persists with decreasing temperature as T down to a temperature $(b)/(D) \sim$, where b = the lattice spacing constant and D is the kink width. (auth)

21071 (NP-10229) PROCEEDINGS OF THE AIR FORCE-NAVY-INDUSTRY PROPULSION SYSTEMS LUBRICANTS CONFERENCE, NOVEMBER 15, 16, 17, 1960. (Wright Air Development Div., Wright-Patterson AFB, Ohio and Southwest Research Inst., San Antonio). Apr. 1961. 249p.

Twenty-two papers are included which were presented at the Air Force-Navy-Industry Propulsion Systems Lubricants Conference at San Antonio. The papers cover lubricant requirements for aircraft engines, gas turbines, rockets, and flight vehicles. A separate abstract has been prepared for one of the papers. (D.L.C.)

21072 (NP-10238) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst., Columbus, Ohio). May 1961. 58p.

An annotated listing of 131 references to selected articles, papers, and reports is presented for high-strength alloys, light metals, nonmetals, refractory metals, coatings and applications. Author, DMIC numerical, and subject indexes are included. (B.O.G.)

21073 (NP-10284) PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM. Bimonthly Progress Report [for period] March 2 to May 1, 1961. G. E. Spangler and M. Herman (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract NOw 61-0221-d. 8p. (P-A2476-3).

Beryllium single crystal tensile data from a series of specimens prepared from materials of various impurity levels showed that there is a definite effect of impurities on the critical resolved shear stress for basal glide in beryllium. It was also apparent that extensive basal plane glide can be achieved. One zone-melted single crystal specimen, with the basal plane initially at 45° to the tensile axis, underwent 140% elongation. The relation between ductility and purity was not so well defined. It appeared that testing variables play a role in determining ultimate ductility. (M.C.G.)

21074 (NRL-5473) STUDY OF COKE-AGGREGATE CONCRETE AS A SHIELD TO ELECTROMAGNETIC RADIATION. P. F. Nicholson (Naval Research Lab., Washington, D. C.). Feb. 29, 1960. 10p.

The electromagnetic behavior of a coke-aggregate concrete as a shield to radiation was investigated. Measurements were taken on a sample at frequencies of 1 to 1000 Mc. The loss-frequency characteristics can be predicted with reasonable accuracy by the adaptation of classical propagation theory to the transmission of electromagnetic waves through an imperfect conductor. With a knowledge of the approximate value of complex permittivity and a measurement of d-c conductivity, substitution of these parameters into a general equation will yield the total insertion loss at the desired frequency. (auth)

21075 (NP-tr-510) STUDYING ALLOYS OF NONFERROUS METALS. Translation of Issledovanie Splavov Tsvetnykh Metal., Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, No. 2, 19-23; 104-13; 114-21; 197-204(1960). 43p. (MCL-688/I)

Four papers are included; separate abstracts have been prepared for each. (C.J.G.)

21076 (NP-tr-510(p.8-19)) ON THE APPLICATION OF THE METHOD OF DRAWING THE SOLID PHASE FROM FUSION FOR THE PLOTTING OF STRUCTURAL DIAGRAMS. D. A. Petrov and B. A. Kolachev Issledovanie Splavov Tsvetnykh Metal., Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, No. 2, 104-13(1960).

It is shown that the Chokhral'skiy method of extracting the solid phase from fusion can be applied successfully for plotting the constitution diagrams for binary and ternary systems. To employ this method it is necessary to know the interrelation of the liquid and solid phase composition and the temperature at the crystallization front. (C.J.G.)

21077 QUANTUM EFFECTS IN DIFFUSION: INTERNAL FRICTION DUE TO HYDROGEN AND DEUTERIUM DISSOLVED IN α-IRON. W. R. Heller (IBM Research Center, Yorktown Heights, N. Y.). Acta Met., 9: 600-13 (June 1961).

A torsion pendulum is employed which can be used in a Collins cryostat at temperatures from 4.2° to 300°K. A peak of damping is found in the range 105° to 120°K. An additional peak associated with hydrogen is found at 30°K and one associated with deuterium is found at 35°K. Magnetomechanical damping is found at all temperatures, with a peak in the range 4.2° to 15°K depending upon treatment of the metal specimen. Theoretical arguments suggest that the isotope-shifted peaks are due to atoms dissolved in the undistorted lattice, whose motion must be treated quantum-mechanically to account for the experimental results. Tunneling and localized lattice distortions around the dissolved atom are required by the data and are within the scope of a reasonable theory. (auth)

21078 A SKIMMING PROCESS FOR THE REMOVAL OF OXIDE FROM THE SURFACE OF SODIUM–POTASSIUM ALLOY. E. K. Inall (Australian National Univ., Canberra). Brit. Chem. Eng., 6: 386-7(June 1961).

Most of the oxides of sodium-potassium alloy (Na-K) float on the surface at room temperature, therefore, it is difficult to entrain the oxides in the flow to a filter. A method used to skim the oxide from the main storage tank of a system handling 1000 gal of Na-K is described that avoids any moving parts within the Na-K system. A filter which is very suitable for holding a large load of filter cake from the Na-K without blocking is also described. (auth)

21079 FRENCH NUCLEAR GRAPHITE. II. TESTING FACILITIES. P. Cornuault (Usine Péchiney, Chedde, France). Bull. inform. sci. et tech. (Paris), No. 48, 6-11(Feb. 1961). (In French)

The testing facilities of the Chedde plant consist of a test station, a pilot plant, and a laboratory for controlling the various raw materials. These are described. (auth)

21080 METALLIC THORIUM. G. A. Meerson and A. F. Islankina. Planseeber. Pulvermet., 8: 173-87(Jan. 1961). (In German)

The principal methods for the production of metallic thorium (reduction of thorium chloride with potassium, reduction of the dioxide, electrolysis of halogen salts, and the iodide method) are briefly reviewed. Then investigations on the extent to which the properties and method of preparation of crude thorium powder affect the compression properties and behavior during sintering are summarized. (J.S.R.)

21081 URANIUM AND URANIUM CARBIDE IGNITION STUDIES. M. Tetenbaum, R. Wagner, L. W. Mishler, and J. G. Schnizlein (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 89-90(June 1961).

21082 INVESTIGATION OF B_4C-Ni ELECTRODISPERSIONS FOR CONTROL ROD APPLICATION. H. E. Williamson, D. L. Zimmerman, and K. C. Antony (General Electric Co., Pleasanton, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 90-1(June 1961).

21083 PREPARATION AND PURIFICATION OF ZIRCONIUM PHOSPHATE AND ZIRCONIUM OXIDE ION-EXCHANGE MATERIALS. N. Michael and D. E. Croucher (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 93-4(June 1961).

21084 RADIATION LEVELS TO BE EXPECTED FROM U-232 AND ITS DAUGHTERS IN THE RECYCLE OF FUELS CONTAINING U-232. P. M. Wood (Neutron Products, Inc., Washington, D. C.). Trans. Am. Nuclear Soc., 4: No. 1, 122-3(June 1961).

21085 LAYOUT OF A PLANT TO RECYCLE FUELS CONTAINING U-232. W. B. Nowak (Nuclear Metals, Inc., Concord, Mass.), B. W. Wessling, and J. A. Ransohoff. Trans. Am. Nuclear Soc., 4: No. 1, 123(June 1961).

21086 EVALUATION OF METAL ALLOYS FOR CLADDING THE FUEL ELEMENTS IN A HIGH TEMPERATURE NITROGEN-COOLED REACTOR. G. W. Titus and J. S. Brunhouse (Aerojet-General Nucleonics, San Ramon, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 148(June 1961).

21087 SEPARATION OF COATED FUEL PARTICLES FROM A GRAPHITE MATRIX. R. A. Ewing, T. S. Elleman, and R. B. Price (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Nuclear Soc., 4: No. 1, 152-3(June 1961).

21088 IMPROVEMENTS IN OR RELATING TO THE PURIFICATION OF GRAPHITE. Hugh Wilson Davidson and Howard Harold Walter Losty (to General Electric Co. Ltd.). British Patent 867,908. May 10, 1961.

A method of purifying a quantity of graphite containing one or more impurities having or liable to have long life activity or activities after irradiation in a nuclear reactor is described. It consists of heating the graphite in a furnace to at least 2500°C in a stream of inert gas. The heating may be carried out in any suitable furnace and it will be necessary to ensure, by maintaining a flow of inert gas that, on cooling, the impurities do not condense back upon the quantity of graphite, possibly in the form of an article or body, being treated. This method may be applied to the purification of machined graphite support sleeve for fuel element of a nuclear reactor. (N.W.R.)

21089 ALLOYS OF BERYLLIUM WITH PLUTONIUM AND THE LIKE. Oliver J. C. Runnalls (to Atomic Energy of Canada, Ltd.). Canadian Patent 615,734. Mar. 7, 1961.

A method for producing alloys of Be with at least one of a group of metals consisting of U, Pu, Ac, Am, Cm, Th, and Ce is presented. The method consists of mixing a fluoride of at least one of the metals with Be and heating the mass at 1000 to 1350°C in vacuum to reduce the fluoride and alloy the reduced metal. These alloys are useful as neutron source materials. (N.W.R.)

21090 METHOD AND APPARATUS FOR IRRADIATION OF MATERIAL. Karl H. Steigerwald (to Carl Zeiss). Canadian Patent 617,156. Mar. 28, 1961.

A method and device for working a material by focusing a beam of charged particles on a discrete area of the material are described. The production of boreholes is an example of this method. The method consists of continuously controlling the intensity of the beam intermittently in such a manner that a physical change of the area is only affected during the resulting beam impulses. The intervals between the pulses are sufficiently long to allow heat concentrated at the discrete area to be conducted to adjacent portions of the material without causing a physical change of the portions. The device consists of a beam producing system, an electromagnetic lens for focusing the beam on the material, an electromagnetic deflecting system, and a controlling device for controlling the focusing power of the focusing lens intermittently in such a way that the beam of charged particles is brought out of focus in the impulse pauses. (N.W.R.)

21091 APPARATUS TO PREPARE MATERIAL FOR IRRADIATION. Freerk J. Fontein and Bauke S. Sleswerda (to Stamicarbon N. V.). Canadian Patent 617,849. Apr. 4, 1961.

Rollers suitable for use in preparing loose solid material such as coal and ores for illumination of irradiation by a measuring instrument which yields an indication of the quality of the material is described. The rollers are constructed to preserve a constant distance between a radiation source and the successive irradiated portions of the body not withstanding variations in the thickness of the body. The rolling and compacting device consists of two rollers one at least of which is a driven roller. The rollers are mounted in juxtaposition so that finely divided material can be fed between the peripheral surfaces of the rollers and can be compacted. One of the rollers is formed to retain the compacted material against its surface as the material emerges from between the rollers. Grooves within one roller retain the material for measurement. (N.W.R.)

21092 PRODUCTION OF PURE LITHIUM SALTS FROM AQUEOUS SOLUTIONS CONTAMINATED WITH OTHER SOLUBLE SALTS. J. Claus and R. Gauguin (to Péchiney). German Patent DAS 1 044 787. Nov. 27, 1958.

Lithium is precipitated as insoluble fluoride, phosphate, borate, oxalate, or preferably carbonate in the presence of a 50 to 100% excess of the sodium or potassium salt of an organic acid, preferably EDTA (ethylenediaminetetraacetic acid) or NTA (nitrilo-triacetic acid). The pH of the reactive components is kept between 7 and 12. The acid forms soluble complexes with most of the cations which are present as impurities; Mn, Mg, Al, Fe, Ca, Ba, Sr, etc. The organic acid is periodically regenerated from the residual solution, and recycled as sodium or potassium salts. (EURATOM)

Corrosion

21093 (ANL-6207) CORROSION OF ALUMINUM AND ITS ALLOYS IN SUPERHEATED STEAM. J. E. Draley, W. E. Ruther, and S. Greenberg (Argonne National Lab., Ill.). Apr. 1961. Contract W-31-109-eng-38. 31p.

The corrosion behavior of pure aluminum and some of its alloys in superheated steam was found to depend markedly on the method of starting the corrosion test. Pure aluminum samples survived only in tests that were brought to temperature and pressure very rapidly. Resistant Al–Ni–Fe alloys performed well only if a relatively slow starting procedure was used, suffering extensive blistering or complete disintegration in a test started rapidly. Over the range of temperature and pressure investigated, 400 to 540°C and 150 to 600 psig, with optimum starting conditions both pure aluminum and resistant Al–Ni–Fe alloy samples quickly formed a very protective oxide film. Interference colors were noted for exposures of several weeks. Samples surviving a 260-day test at 540°C and 600 psig had less than 1-mg/cm^2 weight gain. Nonresistant alloys disintegrated in short corrosion exposures. A penetrating attack, initiated in only a few spots, rapidly destroyed the samples. The effects of composition, dispersion of second-phase compounds, hydrogen porosity, and pretreatments were investigated for 5.6% Ni–0.3% Fe–0.1% Ti in 540°C, 600-psig steam. It was concluded that porosity produced by corrosion product hydrogen was a major factor in the survival of samples. A mechanism for the rapid penetrating attack was proposed as based on observations made during the study of hydrogen porosity. Pretreatment of resistant alloy samples in dry air at 540°C or in high-temperature water at 350°C greatly reduced the amount of porosity produced by corrosion in superheated steam. (auth)

21094 (KAPL-2149) HYDROGEN ABSORPTION BY ZIRCONIUM-2 at.% TIN-2 at.% NIOBIUM ALLOY DURING CORROSION. H. A. Fisch (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 19, 1961. Contract W-31-109-Eng-52. 21p.

The products of the corrosion reaction between Zr–2 at.% Sn–2 at.% Nb alloy and high temperature water or steam were an adherent film of ZrO_2 and H. A portion of this H was absorbed by the alloy. At 600 to 900°F in water and steam, the ratio of absorbed H to O was 0.01322. This ratio was the same for both the pretransition and posttransition regions of the corrosion weight gain curve. Preliminary data indicated that the ratio may be independent of heat-treatment conditions and up to 30% cold-work. Metallographic and x ray examination showed that the absorbed H was precipitated as ZrH. At total H concentrations up to 600 ppm, the highest concentration observed, the hydride precipitate was found only in the Nb-rich grain boundaries. (auth)

21095 (ORNL-2832) CORROSION ASSOCIATED WITH FLUORINATION IN THE OAK RIDGE NATIONAL LABORATORY FLUORIDE VOLATILITY PROCESS. A. P. Litman and A. E. Goldman (Oak Ridge National Lab., Tenn.). June 19, 1961. Contract W-7405-eng-26. 188p.

Chemical corrosion on reaction vessels and equipment used during the fluorination of fused-salt fuels and subsequent associated operations in the Oak Ridge National Laboratory (ORNL) Fluoride Volatility Process was evaluated. Corrosive attack is reported as mils per month based on molten salt residence time or mils per hour based on fluorine exposure time. Two fluorinators were used in the VPP to carry out the fluorination reactions. These vessels, Mark I and Mark II, were fabricated into right cylinders, approx 4½ ft in height, from the same heat of L (low carbon nickel. The first vessel contained equimolar $NaF-ZrF_4$ or $NaF-ZrF_4-UF_4$ (48-48-4 mole %) for approx 1250 hr at 600 to 725°C. Over a period of 61 hr, 57,500 standard liters of F_2 were sparged into the slats. This constituted a F_2:U mole ratio of 3:1 beyond theoretical requirements. The Mark II fluorinator contained fluoride salts of approximately the same compositions plus small additions of PuF_4 during three runs. The salts were kept molten at 540 to 730°C for approx 1950 hr and about sixty 500 standard liters of F_2 were sparged into the Mark II melts in 92 hr. Both fluorinators sustained large corrosion losses consisting of extensive wall thinning, severe interior intergranular attack, and a moderate exterior oxidation attack. Maximum deterioration on the Mark I vessel occurred in the middle vapor region at a calculated rate of 1.2 mils/hr, based on fluorine sparge time, or 46 mils/month, based on time of exposure to molten salts. The second vessel showed maximum attack in the salt-containing region at similarly calculated rates of 1.1 mils/hr and 60 mils/month. Some evidence was found to indicate that the intergranular attack may have resulted from sulfur in the systems. Bulk metal losses from the vessel's walls were believed to be the result of cyclic losses of NiF_2 "protective" films. The shift in maximum corrosion attack geometry in the two fluorinators is believed to have resulted from differences in operating conditions. The Mark II vessel experienced higher temperatures, longer fluorine exposure times, and uranium residence times in its salt baths. Specimens removed from the wall of the first fluorinator showed a variation in average ASTM grain-size number of 5 or 6 to >1, the largest grains being found in the middle vapor region. The second vessel had a more uniform grain-size pattern, average ASTM grain-size numbers varying from 3 to 5 to 2 to 4. The variations in grain sizes are believed to have resulted from variable heating rates during initial usage. Examinations of bench-scale reactors, where simulated fluorination environments were provided to study process variables and corrosion, showed that A nickel had the highest degree of corrosion resistance as a fluorinator material of construction when compared with Inconel and INOR-8. Intergranular penetration and subsequent sloughing of whole grains seemed to be the predominant mode of corrosive attack on the Inconel vessel. At the higher test temperatures, 600°C, INOR-8 miniature fluorinators showed large bulk metal losses plus selective losses of chromium, molybdenum, and iron from the exposed alloy surfaces. Evidence of a marked reduction in attack on nickel and INOR-8 was found during lower temperature studies at 450 to 525°C. Scouting corrosion tests were performed in the VPP's fluorinators using rod, sheet, or wire specimens of commercial and developmental alloys. These tests were subjected to serious limitations due to the lack of control over operating conditions and thus considerable variation in the corrosion of L nickel control specimens resulted. Those nickel-rich alloys containing iron and cobalt showed some superiority in corrosion resistance when compared with L nickel specimens. Nickel-rich alloys containing molybdenum additions showed variable behavior in the fluorination environment. Additional experimental nickel-base alloy corrosion specimens, containing magnesium, aluminum, iron, cobalt, or manganese, were fabricated for use in future screening tests in a subsequent pilot plant fluorinator. A review of one fluorination test series conducted by the Argonne National Laboratory gave general agreement with ORNL scouting corrosion test specimen results. Visual and metallographic examinations plus ultrasonic measurements of other VPP vessels and equipment fabricated generally from Monel or Inconel showed a wide variation in resistance to those various local service conditions. The studies suggest that Inconel can continue to be used as a material of construction for some components but frequent inspections are indicated. Monel appears gen-

erally satisfactory for the applications to date. From a corrosion standpoint, the fluorination vessel in the VPP continues to be the most vulnerable to attack due to the nature of the contained environment and the high temperature necessary for fluorination. The continued use of L nickel for the fluorination vessel does not appear prohibitive for batch operations only due to the present high value of the pilot plant's product. Although not conclusively proven for the fluorination vessels, reduction of sulfur contamination and the ensuring of a uniform, small-grain size in the vessels may improve vessel performance. (auth)

21096 (TID-11307) THE SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 7. MERCURY MATERIALS EVALUATION AND SELECTION. James J. Owens, James F. Nejedlik, and J. William Vogt (Thompson Ramo Wooldridge Inc., Cleveland.). Oct. 26, 1960. 143p. (ER-4103)

The SNAP II system consists of a reactor heat source, a mercury Rankine engine, and an alternator. The problems involved in selecting materials for the SNAP II mercury system were studied. A discussion is given of the corrosion mechanisms involved in a system in which mercury is the working fluid. The problem resolves itself into selecting materials with the best combination of engineering properties for the application and highest resistance to mercury corrosion at the anticipated temperature. (auth)

21097 (CEA-tr-A-758) DE LA THÉORIE DES PHÉNOMENÈS D'OXYDATION SUPERFICIELLE DES ALLIAGES MÉTALLIQUES. (Theory of Surface Oxidation Phenomena on Metallic Alloys). K. Hauffe. Translated into French from Wiss. Z. Univ. Greifswald, 1: 5-13(1951). 36p.

A review is presented on oxidation films and oxidation layers this being defined as relatively thick surface layers, compact, and electrically neutral. (43 references). (T.R.H.)

21098 (CEA-tr-A-818) TYPES DE RÉACTIONS D'OXYDATION DES ALLIAGES. (Types of Oxidation Reactions of Alloys). C. Wagner. Translated into French from Z. Elektrochem., 63: 772-90(1959). 78p.

The oxidation of alloys differs from that of pure metals in the following respects: Depending on the form of the equilibrium diagram, on the affinities to oxygen of the alloying elements, and on the mobilities of the cations of the oxide phases formed, certain zones of the oxide layer and of the adjoining alloy become enriched with respect to some of the alloying elements. In many cases, the oxide layer consists of several zones containing two or more phases each, such as a mixture of noble metal and an oxide of the less noble component, or of two oxide phases like Cu_2O and NiO on Cu–Ni alloys. In a number of limiting cases of reactions types, it is possible to give a quantitative analysis for several phases of the contributions of the diffusing components. 60 references. (auth)

21099 (NP-tr-510(p.1-7)) THE BEHAVIOR OF ALLOYS DURING A CONTACT WITH SODIUM. S. T. Kishkin and G. P. Benediktova. Issledovanie Splavov Tsvetnykh Metal., Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, No. 2, 19-23(1960).

The durability of a number of alloys (containing Cr, Ti, Mo, W, and B in amounts not specified) in contact with Na at high temperatures was investigated. (C.J.G.)

21100 CONTRIBUTION TO THE STUDY OF URANIUM OXIDATION IN CARBON DIOXIDE AT HIGH TEMPERATURES. J. Païdassi, M. L. Pointud, R. Caillat, R. Darras (Centre d'Etudes Nucleaires, Saclay, France). Acta Met., 9: 515-18(May 1961). (In French)

Uranium was oxidized in dry CO_2 at temperatures from 450 to 700°C for periods from 1 to 100 hours. Tabulated data and photomicrographs show the extents of carbide and oxide formation. (D.E.B.)

21101 PROBLEMS OF AQUEOUS CORROSION IN THE FIELD OF NUCLEAR ENERGY. H. Coriou. Bull. inform. sci. et tech. (Paris), No. 49, 46-68(Mar. 1961). (In French)

After a brief study of the main forms of aqueous corrosion, the effect of radiations and the testing methods generally used are studied. The behavior of various nuclear materials (uranium, aluminum, zirconium, Zircaloy, stainless steels, and nickel alloys) is considered in the cases of water-cooled reactors and homogeneous reactors. (auth)

21102 THE OXIDATION OF ZIRCONIUM ALLOYS IN DRY OXYGEN. C. J. Kubit and E. Landerman (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 91(June 1961).

21103 BOILING POTASSIUM IN A COLUMBIUM-1% ZIRCONIUM CONTAINER AT 2000-2200°F. R. J. Teitel (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 91-2 (June 1961).

Fabrication

21104 (AD-248201) DEVELOPMENT AND PRODUCTION OF IMPROVED MOLYBDENUM SHEET BY POWDER METALLURGY TECHNIQUES. Interim Report No. 5, July 1, 1960–August 31, 1960. Russell C. Nelson, Roger B. Bargainnier, Charles Wurms, and Lauri D. Tiala (Sylvania Electric Products Inc. Chemical and Metallurgical Div., Towanda, Penna.). Sept. 30, 1960. Contract NOas 60-6018-c. 87p.

During this report period, rolling and evaluation work continued on Mo alloys containing additives in varying amounts. The research effort centered around additive combinations such as dry-blended TiO_2, ZrO_2, and Al_2O_3, wet-doped TiO_2, ZrO_2, Al_2O_3, ThO_2, Cr_2O_3, Ti, and Ti with ZrH_2 and ZrO_2. Other investigations involved duplication of arc-cast alloys containing Ti, Zr, Nb, W, C, and Mo plus 30% W. Recrystallization studies were completed on all alloys except the arc cast. Room-temperature tensile tests in the as-rolled, stress-relieved, and recrystallized conditions are essentially complete for all alloys in the first 3 groups. Wet-doped Mo–1.0 Cr_2O_3 had the highest room temperature tensile strength. Tensile strength at 2200°F was determined on a few of the better alloys. Vacuum arc-cast 0.040 in. Mo–0.5 Ti sheet was received from two sources. For purposes of comparison with our powder metallurgy alloys, the arc-cast sheet was tested for recrystallization behavior and tensile strength. In the powder rolling feasibility study, optimum temperatures for sintering and re-rolling were established. Under these conditions, sheet material can be made with a tensile strength of at least 130,000 psi. An investigation of the flow characteristics of Mo powders was initiated to find a correlation with their behavior in powder rolling. Mechanical properties of sheet re-rolled to 0.010 in. were determined. (auth)

21105 (AWRE/LIB/BIB/2) EXPLOSIVE FORMING. REFERENCES TO UNCLASSIFIED REPORTS AND ARTICLES PUBLISHED FROM JANUARY 1957–SEPTEMBER 1960 WITH A SUPPLEMENT UP TO DECEMBER 1960. AWRE Bibliography No. 2. Dorothy Beck (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). May 1961. 11p.

A bibliography is presented consisting of 153 references to articles and reports published from Jan. 1957 to Dec. 1960, on explosive forming techniques. References were obtained principally from: Engineering Index, 1957 and 1958; Applied Science and Technology Index, 1958 to June 1960; and Reviews of Metal Literature, January to July 1960. (B.O.G.)

21106 (BMI-X-169) ZIRCALOY-STAINLESS STEEL BONDING PROGRAM; SECOND QUARTERLY REPORT, MARCH 1961 TO JUNE 1961. S. W. Porembka (Battelle Memorial Inst., Columbus, Ohio). May 31, 1961. 13p.

Investigation of a two-stage friction-bonding cycle for joining Zircaloy-2 and Type-410 stainless steel is reported. The specimens were designed to achieve sufficient upset pressures using existing equipment. Studies on explosive joining were directed toward defining the charge limitations for tubes of the CANDU geometry. The roll forming equipment was assembled and preliminary tests were initiated. (J.R.D.)

21107 (DMIC-Memo-109) REVIEW OF RECENT DEVELOPMENTS IN METALS JOINING. J. J. Vagi, H. E. Pattee, H. W. Mishler, R. E. Monroe, and R. M. Evans (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). May 25, 1961. 5p. (PB-171628)

Major developments in metals joining are summarized from information received in Feb. 1 to April 30, 1961. Among the topics treated are refractory metals, titanium, rocket motor cases, ultrasonic welding, and adhesive bonding. (D.L.C.)

21108 (ISC-1109) PRELIMINARY SINTERING CHARACTERISTICS OF ALUMINUM OXIDE. D. R. Wilder (Ames Lab., Ames, Iowa and Iowa State Coll., Ames). 1958? 60p.

A study of aluminum oxide sintering is presented. A review of the literature is included along with descriptions of experimental technique and results. It was found that this material becomes more active when heated because of loss of surface adsorbed material. Changes in slaking characteristics observed when the material is heated are owing to sintering initiation rather than the loss of surface adsorbed ions. Sintering starts with a complex mechanism which cannot be described by an Arrhenius equation. (J.R.D.)

21109 (NAA-SR-Memo-6041) MICROSTRUCTURAL INVESTIGATION OF HOT PRESSED URANIUM CARBIDES USING EXTREMELY HIGH PRESSURES. C. G. Rhodes (Atomics International. Div. of North American Aviation, Canoga Park, Calif.). Jan. 16, 1961. 10p.

Microstructures of hot-pressed UC specimens were examined to determine the sintering characteristics relative to temperatures of 518 to 1490°C and pressures of 10 to 46 k atmos. Measurements of the volume percent porosity of each sample were made by lineal analysis. The causes of inter-granular microcracks observed in the specimens are discussed. X-ray-diffraction studies of hot-pressed samples indicate that the grains were fragmented into subgrains and the size and perfection of the subgrains varied with the pressing temperature. (B.O.G.)

21110 (NMI-7208) EVALUATION OF THE PROTOTYPE SET OF ZIRCALOY-4-CLAD UNALLOYED URANIUM OUTER TUBES NOS. 95 AND 97 EXTRUSIONS NOS. 28965 AND 28967. H. F. Sawyer and E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). Apr. 24, 1961. Contract AT(30-1)-1565. 35p.

A summary is presented of data obtained in the evaluation of two tubes which were fabricated as part of a prototype set of three unalloyed outer thin-walled tubes containing a modified core-to-end seal preshape configuration designed to give more uniform cladding at the end taper regions in the coextruded tube. The third tube in the prototype set was damaged during extrusion and was not processed further. The evaluation data show that the tubes meet all the required specifications except: the cladding thickness at the front outside of Tube No. 95, where the minimum cladding thickness as determined by autoradiography is 16.9 mils or 0.1 mil below the target minimum of 17.0; and both tubes bowed slightly during autoclaving. Tube 95 has a 0.20-in. bow, and Tube 97 has a 0.17-in. bow. The maximum bow allowed under the specifications is 0.12 in. Both tubes had two beta-heat treatments, the first with an oil quench, and the second with an air cool. The double heat treatment should be kept in mind in planning future tests for the tubes. (auth)

21111 (NMI-7209) EVALUATION OF THE DEMONSTRATION SET OF ZIRCALOY-4-CLAD UNALLOYED URANIUM OUTER TUBES NOS. 108-112 EXTRUSION NOS. 29778 TO 29782. H. F. Sawyer and E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). May 2, 1961. Contract AT(30-1)-1565. 49p.

Detailed and summary data are presented for five tubes which comprise a set intended to demonstrate the feasibility of fabricating by coextrusion, thin-walled unalloyed uranium outer tubes clad with Zircaloy-4 and with integral zirconium end seals. The evaluation data are tabulated. (auth)

21112 (NMI-7238) POWER REACTOR PROGRAM. PROGRESS REPORT TO SAVANNAH RIVER OPERATIONS OFFICE, UNITED STATES ATOMIC ENERGY COMMISSION FOR THE PERIOD MARCH 1, 1961 THROUGH MARCH 31, 1961. S. Isserow, R. W. Anderson, W. J. Richmond, W. B. Tuffin, W. L. Larson, P. R. Smoot, D. M. Davies, H. M. Green, and A. R. Gilman (Nuclear Metals, Inc., Concord, Mass.). May 11, 1961. Contract AT(30-1)-1565. 26p.

An evaluation of two thin-walled outer tubes showed that more extensive alpha working of the billet core stock results in more uniform cladding on the extruded tube. In an effort to eliminate breakthrough and to reduce eccentricity, shift, and bending of the mandrel, two experimental copper-nickel billets with Zircaloy sleeves were extruded to check a modified billet design. It was observed that the final grain size of the unalloyed uranium core of a thin-walled outer tube is insensitive to small variations in the cooling rate from the beta-treatment temperature. An axial load of 3000 pounds applied to a thin-walled outer tube during autoclaving was ineffective in preventing bowing of the tube. Shipping experiments demonstrated that current packaging methods of thin-walled inner tubes do not prevent bowing during transit. The fabrication of specimens for the capsule irradiation program was concluded with the shipment of sixteen specimens and excess extruded tube stock to Savannah River Laboratory. The following core compositions were represented: U-1 wt.% Si, unalloyed dingot uranium, U-0.3 wt.% Al-0.5 wt.% Si, and U-0.3 wt.% Cr-0.3 wt.% Mo. All irradiation specimens were supplied in the beta-treated condition. The mechanical behavior of Zircaloy-4-clad dingot uranium tube sections was evaluated as a function of the cooling rate from the beta treatment temperature. The results indicate that the mechanical behavior is approximately independent of the cooling rate and that, in testing to failure, fracture initiates within the core. Also, in a similar test of a transient-melted ingot uranium tube, the uranium core appeared to be the most brittle component. Five tubular stainless steel-Zircaloy joints were extruded

for use in an experiment to determine if such joints can withstand 30 and 40% cold reductions. (auth)

21113 (NP-10275) TANTALUM EXTRUSION PROGRAM. STATE-OF-THE-ART SURVEY. Interim Technical Report No. 1, December 2, 1960–March 2, 1961. (Battelle Memorial Inst., Columbus, Ohio). For Wah Chang Corp. Contract AF33(600)-42396. 129p.

A survey of physical and mechanical property data and present day fabrication know-how for ingot production and extrusion practice is presented. There are a limited number of tantalum alloys for which data exists. The commercial tantalum alloy is the Ta–10%W alloy. Very little data are available on extruding tantalum alloys. The state-of-the-art survey will be a guide in determining the necessary melting practice and initial breakdown of the Ta–10%W ingots. (auth)

21114 (NP-10303) INVESTIGATION OF THE EFFECTS OF PROCESSING VARIABLES AND FABRICATION TECHNIQUES UPON THE PROPERTIES OF INTERMETALLIC COMPOUNDS. Progress Report No. 4, January 1, 1961–March 31, 1961. Technical Report No. 210-229. R. S. Truesdale, B. B. Lympany, E. M. Grala, C. A. Bieiawski, R. M. Paine, and W. W. Beaver (Brush Beryllium Co., Cleveland). Apr. 15, 1961. Contract AF33(616)-7108. 75p.

Sinterability studies were conducted on Nb_2Be_{17} cold-pressed compacts. The variables studied were particle size, iron content, and sintering time and temperature in relation to density, grain size, and strength. High modulus-of-rupture strengths (56,700 to 65,000 psi) were obtained for fine-grained (21-micron) materials of greater than 95% of theoretical density tested at 2300 to 2500°F. Fine grain size resulted from sintering fine powders (7.8 micron) at 3020°F for two hours. Small particle size powders provided lower sintering temperatures and broader sintering ranges which resulted in high density and fine grain size. The feasibility of fabricating intermetallic shapes by isostatic pressing, extrusion, investment casting, and flame spraying was also demonstrated. Large shapes were fabricated by cold pressing and sintering and by hot pressing. Upsetting studies conducted on $NbBe_{12}$, Nb_2Be_{17}, and Nb_2Be_{19} revealed that Nb_2Be_{19} had the highest rate of reduction, which was approximately 42% per minute at 3000°F. Nb_2Be_{17} had a lower rate of reduction but provided much higher resistance to cracking. Changes observed in the microstructure of these materials upset at elevated temperatures included some grain growth and a slight amount of preferred orientation. Nb_2Be_{17} was the most stable compound at 3000°F. (auth)

21115 (ORNL-3124) INOR-8-GRAPHITE-FUSED SALT COMPATIBILITY TEST. R. C. Schulze and W. H. Cook, R. B. Evans, III, and J. L. Crowley (Oak Ridge National Lab., Tenn.). June 15, 1961. Contract W-7405-eng-26. 43p.

For the purpose of evaluating the compatibility of graphite and INOR-8 in a dynamic fluoride fuel medium, INOR-8 Forced Convection Loop No. 9354-5 was operated 8850 hr. The loop operated at maximum temperature of 1300°F and circulated a fluoride fuel of the system $LiF–BeF_2–UF_4$. Post-test examinations of the graphite and loop components revealed no apparent corrosion or carburization problems. (auth)

21116 (SCR-302) INVESTIGATION AND DEVELOPMENT OF METHODS FOR PRODUCING HIGH-POROSITY BERYLLIUM BODIES. Final Report. Technical Report No. 164. B. B. Lympany, J. G. Theodore, and W. W. Beaver (Brush Beryllium Co., Cleveland). Jan. 1960. 64p. For Sandia Corp. [Livermore Lab.,] Livermore, Calif.

Methods investigated for producing high-porosity, low-density beryllium bodies were as follows: inducing high porosity with volatilizable additives; utilization of aqueous foaming techniques at room temperature followed by a sintering of the green shape; slip-casting hollow spheres followed by a sintering of randomly packed spheres; preparation of beryllium honeycombs by a combination slip-cast–lost-wax technique; and utilization of fibrous beryllium chips for pressureless-sintered shapes. The merits of each technique are discussed in relation to the objectives of the research program. (auth)

21117 (Y-1343) PRODUCTION OF TUNGSTEN ROCKET NOZZLE INSERTS. Arthur G. Neeley (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Dec. 12, 1960. Contract W-7405-eng-26. 40p.

The equipment and powder metallurgy process used in producing tungsten rocket nozzle inserts is presented. Variations in sintered densities due to differences in tungsten powders are discussed. (auth)

21118 (AEC-tr-4625) EFFECT OF FRICTION ON WALLS OF A CLOSED FORGING DIE ON THE FLOW THROUGH THE OPENING. A. Z. Zhuravlev. Translated from Kuznechno-Shtampovochnoe Proizvodstvo, 9-11(Dec. 1959). 6p.

In order to determine the effect of friction on the walls of a closed forging die on the flow of metal through the hole, the equilibrium condition for a shifting elementary truncated cone in the receiving part and the plasticity condition for a flat deformed plate were used. The effect of maximum friction on the walls of the die on the angle of inclination of the generator of the natural matrix was examined. Just as a certain hardening was observed in the zone of intensive shifts, and relaxation appeared in the adjacent zones, intensive shift was observed over a certain volume rather than on one surface. The following metal had a prolonged effect on the stagnant areas in the corner. Reduction in the angle of inclination of the natural matrix generator with an increase in friction on the die walls was confirmed. (M.C.G.)

21119 (CEA-tr-R-1031) PROTECTION DES ACIERS CONTRE LA CORROSION GAZEUSE PAR DES REVÊTEMENTS EN VERRE-MÉTAL. (Protection of Steels Against Gaseous Corrosion by Glass-Metal Coverings). E. A. Antonova and A. A. Appen. Translated into French from Zhur. Priklad. Khim., 32: 2468-73(1959). 17p.

A Cr–glass coating for protection of steel from corrosion by gases was studied. The glass was a non-alkaline borosilicate. An aqueous suspension of powdered glass and Cr, supported by bentonite, was pressed through a screen with 10,000 holes per cm^2. The H_2O content varied from 30 to 40%; specific weight was 2.0 to 2.65. Steel plates $20 \times 10 \times 3$ mm were coated, dried at 105 to 110°, then heated at 1200 to 1500°C for 1.5 to 2 min. The coating thickness ranged from 0.15 to 0.30 mm. The coating was resistant to rapid temperature changes and high temperatures, and protected the metal well. (T.R.H.)

21120 (NP-tr-605) PRECEDURE FOR IMPREGNATION OF GRAPHITE OR CARBON PIECES WITH CONDENSATION PRODUCTS OF TAR AND FURAN DERIVATIVES, WITH APPLICATIONS. Translated by J. B. Sykes (U.K.A.E.A., Atomic Energy Research Establishment) from French Patent No. 1169208, Dec. 24, 1958. 8p. (Handwritten MS.)

A procedure is described for the impregnation of carbon or graphite pieces with furfural-tar condensation products

polymerized in situ, whose tightness, heat resistance, and corrosion resistance are improved by suitable heat treatment. Characteristics of the procedure are outlined. (B.O.G.)

21121 FRENCH NUCLEAR GRAPHITE. I. FABRICATION. H. des Rochettes (Usine Péchiney, Chedde, France). Bull. inform. sci. et tech. (Paris), No. 48, 3-5(Feb. 1961). (In French)

The principal stages in the fabrication of graphite at the Chedde plant of the Compagnie Pechiney are described. (tr-auth)

21122 THE PREPARATION OF ZIRCONIUM–DEUTERIUM TARGETS. J. Lipták and M. Ryba (Czech Technical Univ., Prague). Ceskoslov. časopis fys., 149-53 (1961). (In Czech.)

The preparation of targets with adsorbed deuterium on a thin deposited layer of zircon at low pressures is described. The atomic ratio of the deuterium to the zircon is between 1.3 and 1.9. (auth)

21123 WELDING STAINLESS STEELS. M. C. T. Bystram (Murex Welding Processes, Ltd., [London]. Nuclear Eng., 6: No. 60, 193-8(May 1961).

Conditions necessary for welding various types of stainless steels are discussed. A constitution diagram for stainless steel welds with approximate regions of defects depending on composition and phase balance is presented. Preheating temperatures for welding hardenable steels and post-heat treatment temperatures are given. Also given is a list of electrode choices for welding mild, low-alloy, nickel-base to iron-base alloys, and different grades of stainless steels in different combinations. The crystal structure of austenite, ferrite, and martensite welded material is also discussed and photographically shown. (N.W.R.)

21124 DEVELOPMENT OF PROCESSES FOR MELTING AND CASTING NUCLEAR REACTOR FUELS. N. H. Katz, D. H. Turner, E. G. Kendall, and M. H. Binstock (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 88-9(June 1961).

21125 DESIGN AND FABRICATION OF HIGH POWER DENSITY FUEL ASSEMBLIES FOR IRRADIATION TESTING IN THE VALLECITOS BOILING WATER REACTOR. W. D. Fowler (General Electric Co., San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 150-1(June 1961).

21126 FABRICATION OF STAINLESS STEEL CLAD URANIUM DIOXIDE FUEL ELEMENTS BY TANDEM ROLLING. J. W. Lingafelter (General Electric Co., Pleasanton or San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 151(June 1961).

21127 FABRICATION OF FUEL ELEMENTS BY SWAGING. E. A. Lees (General Electric Co., Pleasanton, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 151-2(June 1961).

21128 RESISTANCE AUTOBRAZING OF WIRES TO INTERMETALLIC THERMOELECTRIC MATERIALS. W. A. Owczarski (Knolls Atomic Power Lab., General Electric Co., Schenectady, N. Y.). Welding J. (N. Y.), 40: 517-21(May 1961).

A welding process, resistance autobrazing, permits the joining of metallic probes to compound thermoelectric materials. Several of these materials are successfully equipped with probes. Iron, chromel, alumel and platinum probes, among others, are joined to PbTe, Bi_2Te_3 and ZnSb. Wires of several diameters and samples of different geometries are used. The developed process resembles brazing. However, one of the materials to be joined provides filler metal to the joint. The process uses resistance heating to provide the energy required to melt the "filler metal" and complete the joint. (auth)

21129 ASPECTS OF REACTOR FUEL ELEMENT FABRICATION. J. G. Purchas and H. R. W. Cobb (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Welding and Metal Fabrication, 28: 302-8(Aug. 1960).

The properties and uses of various metals and alloys in reactor fuel elements at high temperatures are discussed. Al, Mg, Be, Zr, Nb, and stainless steel are studied, with reference to neutron capture cross sections, structural properties, and welding or brazing properties. Joining methods are described such as controlled atmosphere welding, electron beam welding, and brazing. Leak testing techniques, including He mass spectrometry, are outlined. Nondestructive tests, including radiography, thermal tests, and ultrasonic and eddy-current tests are discussed. (T.F.H.)

21130 MANUFACTURE OF FUEL ELEMENTS WITH FINELY DISPERSED FISSILE AND FERTILE MATERIAL. (to DEGUSSA). Belgian Patent 575,380. Priority date, Feb. 4, 1958.

Porous graphite is impregnated at relatively low temperature with molten uranium, plutonium or thorium, or alloys of these metals which can later be converted into carbides by additional heat treatment. (EURATOM)

21131 MANUFACTURE OF GRANULAR URANIUM CONTAINING MATERIAL. (to Stichting Reactor Centrum Nederland). Belgian Patent 578,613. Priority date, May 14, 1958.

Normally, when an aqueous solution of uranyl nitrate is neutralized by ammonia and precipitated with urea, granular uranium dioxide is obtained; the size of the grains, however, is not homogeneous. The following conditions have to be fulfilled: concentration of urea = 110 to 220 grams per liter, temperature of the solution = 90 to 98°C, and initial concentration of nitrate ions below 1.8 ion-gram per liter. The obtained precipitate is amorphous and can be eventually reduced into uranium dioxide by hydrogen. (EURATOM)

21132 MANUFACTURE OF MOLDED PARTS BY SINTERING WITH GLASS POWDER. R. Waroquier (to S. E. R. A. I.). Belgian Patent 587,095. Priority date, Nov. 10, 1959.

Neutron-absorbing materials for shielding components are manufactured by sintering barite or monazite with lead oxide (Pb_3O_4) and glass powder at 700 to 900°C under a pressure of 400 to 650 kg/cm^2. Sodium glass, borate glass, and phosphate glass can be used. (EURATOM)

21133 MANUFACTURE OF RARE-EARTHBASE STRUCTURAL MATERIALS FOR NUCLEAR REACTORS. R. Waroquier (to S. E. R. A. I.). Belgian Patent 587,096. Priority date, Dec. 2, 1959.

Replacement of the sand, used in concrete shielding for nuclear reactors, with rare earth metal ores, preferably monazite, is described. The ores are given the appropriate grain size by sintering with a binder material such as a borate, phosphate, silicate, borophosphate, borosilicate, or glass powder. (EURATOM)

21134 IMPROVEMENTS IN METHODS OF MANUFACTURING POROUS MEMBRANES. (to Commissariat a l'Energie Atomique). British Patent 867,939. May 10, 1961.

Methods of manufacturing porous membranes for use as diffusion barriers having a high resistance to chemical corrosion are described. A corrosion resistant metallic

abric is coated with a moist paste containing fluorohydro-arbon, chlorofluorohydrocarbon polymers, halogen sub-tituted hydrocarbon greases, or waxes. The fabric coated s subjected to an adhering treatment in particular by roll-ng. The paste contains a plasticizer, liquid paraffin per e or in solution in a solvent such as benzene. The paste s obtained by intimately mixing 100 g of polytetrafluoro-thylene powder, 40 cc of the liquid paraffin, and 20 cc of enzene. The plasticizer is eliminated by dripping, drying nd/or washing with a suitable solvent. (N.W.R.)

1135 IMPROVEMENTS IN OR RELATING TO POROUS DIAPHRAGMS. (to Commissariat a l'Energie Atomique). British Patent 868,837. May 25, 1961.

A process for producing a porous diaphragm of fine pore ize, consisting of forming a support matrix having a pore ize in the range 10 to 100 microns by sintering a particu-ate support material, is described. A metallic oxide sus-ension is subsequently passed through the pores in a fluid f particles whose dimensions fall within the range one nicron to several hundredths of a micron. A surface-ctive agent is added to the suspension before it is sucked rough the support matrix of sintered stainless steel. his process causes a thin metallic film to be deposited n the matrix without appreciably diminishing its porosity. N.W.R.)

1136 METHOD OF SEALING A PIECE IN ONE END OF A TUBE MADE OF A SINTERED MATERIAL. Nguyen hien-Chi and Pierre Plurien (to Commissariat a l'Energie tomique). Canadian Patent 611,944. Jan. 3, 1961.

A method of sealing a piece in the end of a sintered po-ous metallic tube by sintering is described. The method onsists of providing the tube with a larger tube which has light transverse play in the cold state. The larger tube is ut on the tube to be sintered at ordinary temperatures. he tube is then heated to 1100°C and is sintered with a ickel powder at 700°C in vacuum. The sealed piece is laced in the inductor of a high frequency furnace and ooled. (N.W.R.)

1137 MANUFACTURE OF CLAD FUEL ELEMENT. Harrison S. Milne and Franklin Abrams (to Atomic Energy f Canada, Ltd.). Canadian Patent 614,309. Feb. 14, 1961.

A method of forming a clad fuel element for use in a ower reactor is described. The method consists of sub-ecting a bar of fissile fuel to a preliminary nickel plating reatment and then extruding the bar with aluminum to form sheath onto the bar. Before extruding the bar with alu-inum, a copper flash may be added to the nickel coating. N.W.R.)

Properties and Structure

1138 (AFOSR-593) DEFORMATION AND FRACTURE OF CADMIUM AND CADMIUM–MAGNESIUM ALLOYS. Norman S. Stoloff (Columbia Univ., New York). Apr. 1961. Contract AF 49(638)-408. 131p.

An investigation was made of the deformation and fracture of polycrystalline cadmium and Cd–Mg alloys. Twinning and non-basal slip in cadmium single crystals and coarse-grained polycrystals were also studied. Tensile tests were carried out on the cadmium and Cd–Mg alloys to determine flow stresses, work-hardening behavior, fracture strength, and fracture ductility. Variables employed in this investigation included temperature, alloy content, and grain size. Some compression data were also obtained for comparison. Twinning and non-basal slip in single crystals were studied in tension, compression, and bending over a wide temperature range. The results were then analyzed in terms of existing models for plastic deformation and fracture in metals of hexagonal close-packed structure. The yield stress, flow stresses for arbitrary small strains, and the average coefficient of work hardening for cadmium polycrystals were found to be relatively insensitive to temperature in the range from room temperature to 4.2°K. The tensile strength of cadmium was strongly temperature dependent but relatively independent of grain size between room temperature and −175°C. Below −175°C, the tensile strength was dependent on grain size, but not on temperature, for a given grain size. The fracture stress and yield stress at −196°C were found to depend on grain size. Cadmium underwent a ductile to "quasi-brittle" transition at about −155°C. The decrease in ductility did not involve recrystallization during deformation. The addition of magnesium to cadmium produced a large increase in yield strength at all temperatures. Tensile strengths and fracture strengths were also raised but not as much as the yield strengths. The increase in tensile strength was approximately proportional to the weight per cent of magnesium added. Transcrystalline fractures were achieved in some grains of a 4.95% magnesium alloy. This alloy exhibited much less twinning than pure cadmium or any of the other alloys. Basal cleavages were achieved in two alloys. Pyramidal $\{11\bar{2}2\}$ slip was found to operate in cadmium single crystals oriented with $\chi_0 < 5°$. (M.C.G.)

21139 (BM-RI-5796) TITANIUM–GADOLINIUM PHASE DIAGRAM. J. G. Croeni, S. C. Rhoads, C. E. Armantrout, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore). May 1960. 14p.

Results indicate that the system is composed of a single eutectic reaction and a peritectoid reaction involving the alpha-beta transformation of Ti. The eutectic isotherm extends from 1 to 99% Gd at 1240°C. The established eutectic composition is about 95% Gd. The peritectoid reaction occurs at 885°C and extends almost over the entire composition range. Hardness increases slightly with additions of Gd, and little change is obtained by heat treatment. Alloys containing less than 10% Gd are amenable to extensive cold-working, but alloys having higher percentage of Gd content are only moderately cold-workable. All alloys can be hot-worked in iron sheathing at 750°C. Observation indicates that all compositions possess good machinability. Corrosion resistance to water at room temperature is apparently poor, especially in the Gd-rich alloys. (auth)

21140 (CAL-PI-1273-M-8) AN INVESTIGATION OF THE THEORETICAL AND PRACTICAL ASPECTS OF THE THERMAL EXPANSION OF CERAMIC MATERIALS. Summary Report for the Period September 1, 1959–September 30, 1960. Kenneth M. Merz, Harold T. Smyth, and Henry P. Kirchner (Cornell Aeronautical Lab., Inc., Buffalo). Sept. 30, 1960. Contract NOrd-18419. 72p.

Prediction of the thermal expansion coefficient of pure single-phase ceramics was attempted by several methods including the openness concept and its application in homologous series and the calculation of each mode of lattice vibration in alkali halide crystals. Seven materials predicted to have low coefficients were snythesized, tested and found to have low values. The work was extended to include prediction of the thermal expansion coefficient of two-phase bodies using Turner's method. To verify the results of these predictions, several phases were synthesized and measured and the thermal expansion coefficients of three different two-phase systems were investigated. A preliminary investigation resulted in some understanding of the effect of solid

solution atoms on the thermal expansion anisotropy of anisotropic crystals. (auth)

21141 (DMIC-Memo-106) SURVEY OF MATERIALS FOR HIGH-TEMPERATURE BEARING AND SLIDING APPLICATIONS. M. F. Amateau, D. W. Nicholson, and W. A. Glaeser (Battelle Memorial Inst., Columbus, Ohio). May 12, 1961. 76p. (PB-171625)

A review of materials which have properties likely to be useful in sliding-contact applications is presented. Wear and friction data for these materials are included along with discussion, conclusions, and a bibliography of 118 references. (J.R.D.)

21142 (DMIC-Memo-107) A COMPARISON OF THE BRITTLE BEHAVIOR OF METALLIC AND NONMETALLIC MATERIALS. G. T. Hahn and R. I. Jaffee (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). May 16, 1961. 35p. (PB-171626)

A comparison of the nature and properties of brittle metallic and nonmetallic materials is made in order to develop a basis for design of tensile structures. The effects of electron bond, crystal structure, and order on brittleness are discussed. The properties of brittle materials which are important for design are compared. Three design philosophies are discussed: transition-temperature, crack-propagation, and brittle-material. (D.L.C.)

21143 (DMIC-Memo-108) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF TUNGSTEN. V. D. Barth (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). May 18, 1961. 6p. (PB-171627)

A review of recent developments in the technology of W is presented. Included is information on fabrication, properties, and structures and applications. (J.R.D.)

21144 (GEAP-0812) CARBON STEEL FOR A DUAL CYCLE BOILING WATER REACTOR PLANT. W. L. Pearl (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Feb. 20, 1956. 30p.

A summary is given of the data available concerning the use of carbon steel to replace stainless steel in the Commonwealth Edison project (CEP) reactor plant primary cooling system for contact with high-temperature water, or steam and water mixtures. An evaluation of the probable significance of such changes on reactor parameters is also included. (J.R.D.)

21145 (HW-54364) MECHANICAL PROPERTIES OF ALUMINUM ALLOY M-388: EFFECT OF FABRICATION VARIABLES. R. S. Kemper and K. F. Powell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 6, 1958. Contract W-31-109-Eng-52. 30p.

Results of tests made to establish the annealing behavior of the alloy after cold working to 10, 25, and 50% reduction are presented. Included is information on aging, microstructures developed by such treatment, and the effect of grain size on tensile properties. (J.R.D.)

21146 (NAA-SR-Memo-5916) EFFECT OF HYDROGEN CONTENT ON THE TENSILE PROPERTIES OF ZIRCONIUM. J. J. Gill (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1960. 17p.

The tensile properties of zirconium hydrided to 1000 ppm with hydrogen were measured between room temperature and 1200°F. Up to 800°F the presence of these quantities of hydrogen does not affect the ultimate and yield strengths. The ultimate strength appears to be reduced by the addition of 1000 ppm hydrogen at 1000°F and above. The ductility as measured by reduction in area and total elongation is reduced at room temperature by hydriding. Above 250°F the ductility is unaffected by the presence of up to 1000 ppm hydrogen. (auth)

21147 (NP-10155) GROWTH OF CRYSTALS IN ORIENTED AMORPHOUS POLYETHYLENE. ONR Technical Report No. 30. Jane T. Judge and Richard S. Stein (Massachusetts. Univ., Amherst). Apr. 15, 1961. Contract Nonr 3357 (00). 29p.

The growth of crystals from the melt in oriented, cross-linked polyethylene was studied by x-ray diffraction and birefringence as a function of orientation. It was found that, for samples elongated more than ~200%, the crystals grow with their c-axes parallel to the stretching direction. At elongations less than 200%, there is a rather abrupt transition to a mode of growth in which the b-axis is perpendicular to the stretching with a tendency for the a-axis to be aligned parallel to this direction. (auth)

21148 (NP-10184) PRESSURE DEPENDENCE OF THE HALL CONSTANT OF THE ALKALI METALS. Technical Report HP-6. Thomas Frederick Deutsch (Harvard Univ., Cambridge, Mass. Gordon McKay Lab. of Applied Science). July 1, 1960. Contract Nonr-1866(10). 74p.

Band structure calculations by Ham indicate how the Fermi surface of the alkali metals, which is expected to be nearly spherical under normal conditions, may change when the lattice constant is decreased through hydrostatic pressure. Since direct measurement of the distortion of the Fermi surface is difficult, its magnitude was studied by measuring the Hall voltage in the alkalis as a function of hydrostatic pressures to 15,000 kg/cm^2. In each case the Hall voltage decreases with increasing pressure, the size of the decrease ranging from 2% in 15,000 kg/cm^2 for lithium to 37% in 15,000 kg/cm^2 for cesium before compressibility corrections are applied. The Hall constant, R, can be written as 1/Necn* where n* is a factor of the order of unity which expresses the deviation from the free electron value of the Hall constant. The data, with all explicit volume dependence removed, are expressed in the form of curves of n* vs. pressure. In all of the alkalis except cesium, n* decreases monotonically with increasing pressure the decreases range from 5% in 15,000 kg/cm^2 for lithium to 8% in 15,000 kg/cm^2 for rubidium. In the case of cesium n* passes through a minimum at 5000 kg/cm^2 and rises to a value of 1.2 at 15,000 kg/cm^2. The change of n* between room and liquid nitrogen temperatures was measured. In all of the alkalis except lithium the change is less than 3%. In lithium n* decreases by about 25% between room and liquid nitrogen temperature. The warping of a nearly spherical Fermi surface is described by Kubic harmonics and the effect of the warping on n* considered. Increases in the warping parameters increase n*; since the band structure calculations indicate that increasing pressure increases the warping parameters, the data cannot be explained on the basis of anisotropic Fermi surfaces alone. If anisotropic scattering times as well as warped Fermi surfaces are considered, then increases of the warping parameters can cause decreases in n*. The pressure results are explained in a semi-quantitative manner using a scattering time that varies by a factor of three over the Fermi surface. By contrast, the warping of the Fermi surface is small; with the exception of cesium, the electron-wave vector at the Fermi surface deviates from the free electron value by less than 10%. An approximate expression for $\tau(\tilde{k})$ is derived and the factors contributing to the anisotropy in τ are considered. The most important factors are the anisotropy of the velocity of sound and the dependence of the size of the phonon-wave

ector used in umklapp processes upon the initial electron state. A crude calculation shows that with appropriate orms for the electron-phonon scattering matrix element, he latter factor alone can give a scattering time that varies y nearly 70% over the Fermi surface. (auth)

21149 (NP-10240) A SURVEY OF HYDROGEN CONENTS OF CURRENT COMMERCIAL AND EXPERIMENTAL ITANIUM ALLOYS. Max J. Trzeciak, William R. Hansen, nd Manley W. Mallett (Battelle Memorial Inst., Columbus, hio). Mar. 8, 1956. 26p.

A survey of H contents of current commercial and experimental Ti alloys was conducted to determine the effectiveness of producers controls to meet Air Force specifications. Samples were taken from all Ti alloy materials arriving at aircraft and engine manufacturers' plants from eptember 1 to December 1, 1955. Results of H analyses howed that about 15% of 561 alloy sheet samples analyzed xceeded the maximum specification of 150 ppm. Average content for the sheet samples was 116 ppm. The maximum H specification of 125 ppm for bar and forging stock as exceeded by about 1% of a total of 225 samples. The verage H content of the samples of bar and forging stock as 56 ppm. (auth)

1150 (NP-10241) THE ELECTRICAL RESISTIVITY F Mn_3ZnC BETWEEN 4.2° AND 630°K+. Technical Report o. 10. M. L. Swanson and S. A. Friedberg (Carnegie Inst. f Tech., Pittsburgh). May 24, 1961. Contract Nonr 760 05). 10p.

The electrical resistivity of an alloy having approximately ne composition Mn_3ZnC was measured between 4.2° and 30°K. From a high residual value the resistivity increased ith temperature up to 550°K, becoming temperature-indeendent above that point. Two anomalous regions were evient, corresponding to the magnetic transitions occurring in is substance at ~230°K and ~470°K. The general features f the results were interpreted on the basis of a spin-disrder scattering picture. (auth)

1151 (NP-10283) ON THE NATURE OF STRAIN ARDENING IN FACE-CENTERED-CUBIC METALS. Technical Report No. 10. P. W. Osborne, S. K. Mitra, and J. E. orn (California. Univ., Berkeley. Materials Research ab.). May 4, 1961. Contract Nonr-222(49). 44p.

The low temperature tensile and creep behaviors of sine crystals of Cu were evaluated and analyzed in such a anner as to provide an estimate of the separate contribuons of short and long range stress fields to strain-hardeng. Furthermore, the average force-displacement diagram r thermally activated intersection of two dislocations were stablished. This diagram plus a knowledge of the variation dislocation spacing and the long-range back stresses with rain permits an accurate prediction of creep rates. The lculated activation energy for intersection under condions of a constant strain rate increased linearly with the solute temperature as required by theory. (auth)

1152 (NRL-5603) THE EFFECT OF COLD WORK ND TEMPERATURE ON THE STRENGTH AND STRUCURE OF STEEL. P. Shahinian and M. R. Achter (Naval esearch Lab., Washington, D. C.). Jan. 26, 1961. 19p.

An investigation was made to determine the influence of old work on the strength of a low-alloy steel at elevated mperature. The measurements, which include hardness, nsile, and creep-rupture properties, were used to explain e behavior of the material, including an apparent anomaly. addition, optical and electron microscopy, and x-ray-difaction techniques were employed to follow microstructural anges in the steel. The steel in the quenched and tempered condition was strengthened, in a normal manner, in creep-rupture at high temperatures by large amounts of cold work, but was weakened in an anomalous manner by small amounts of deformation. The reduction in strength of the cold-worked steel, compared to an unworked sample, is attributed to an observed increase in mean-free ferrite path, induced apparently by the prior cold work. An explanation is offered for the weakening at small deformations and strengthening at large deformations in terms of two opposing effects of cold work in competition: a softening caused by a microstructural change and a hardening as a result of lattice strain and strain aging. For small amounts of cold reduction the softening predominates, whereas for large amounts the hardening is the more effective. In contrast to the behavior of the quenched and tempered steel, the steel in the annealed condition was strengthened progressively by an increase in prior cold work. (auth)

21153 (PB-161947) STATE OF THE ART—FLAKE-GLASS LAMINATES. Allen M. Shibley (Picatinny Arsenal. Plastics Technical Evaluation Center, Dover, N. J.). Oct. 1960. 130p. (Plastec Report-1).

An evaluation of flake-glass laminates for structural, electrical, and other uses is presented. Methods of manufacturing and testing glass flake are described and illustrated. Compositions of various types of suitable glasses are indicated. Resin coatings and methods of applying these coatings are also described and illustrated. Optimum resin systems are detailed. Methods used for the manufacture of flake-glass laminates are given in detail. Tests of tensile and flexural strengths, and of modulus, are described. Comprehensive data on a wide variety of physical characteristics, as measured by standard and military specifications, are also included. (auth)

21154 (RADC-TR-60-233) STUDY OF HIGH TEMPERATURE MATERIALS. Final Report. (New Jersey. Ceramic Research Station, New Brunswick). 1960. Contract AF30(602)-2058. 38p. (AD-248105)

Wave guide equipment was designed and built for the evaluation of ceramic materials for high-frequency energy absorbers. Tests were conducted on eleven selected ceramic compositions at 10,000 Mc and 80 to 1200°F. A coaxial line was designed and built for making evaluations at 80 to 3000 Mc. (B.O.G.)

21155 (RAE-TN-MET-PHYS-325) SILICON CARBIDE—A REVIEW. A. R. G. Brown (Gt. Brit. Royal Aircraft Establishment, Farnborough, Hants, England). Aug. 1960. 37p. (AD-249685)

Published information on the production of pure silicon carbide and the fabrication of dense bodies of pure self-bonded SiC is reviewed. The structure and growth mechanism of SiC are considered and the major chemical, physical, and mechanical properties presented. (82 references). (auth)

21156 (WADD-TN-60-242) THE APPLICATION OF COMPUTER TECHNIQUES TO PREFERRED ORIENTATION STUDIES. J. R. Holland (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Aug. 1960. 13p.

A method was devised for plotting normalized pole figures by computer techniques. The data required from the traces are entered onto punch cards. Corrections for defocusing effects may be readily made as the data are transferred from the Brown recorder traces to punch cards. It is possible to program other correction factors into the computer operations, providing that these correction factors or curves can be established accurately. The

computer translates angular position of the specimen into rectilinear co-ordinates which are an identical representation of stereographic co-ordinates. This computer method was used in conjunction with the Schulz reflection technique, but modification of the computer program permits its use with other quantitative x-ray techniques for determining preferred orientation. (auth)

21157 (CEA-tr-A-789) PROPRIÉTÉS DES MÉTAUX ET ALLIAGES AUX BASSES TEMPÉRATURES. (Properties of Metals and Alloys at Low Temperatures). E. Justi. Translated into French from Z. Metallk., 51: No. 1, 1-17 (1960). 62p. (Includes original, 17p.).

A review is presented of the properties of metals and alloys at low temperatures. The Bloch-Grüneisen theory on temperature effects on electric resistivity of pure unstressed metals is considered, and experimental verifications are described. Contradictions are discussed such as differences between calorimetric and resistometric Debye temperature. Experimental proofs of the T^2 law governing the resistance of numerous pure metals are collected and explained in the light of damping potentials. The appearance of a minimum for ρ at liquid He temperatures is established and discussed. New experimental data on the variation of transversal and longitudinal magnetic resistance are treated and its non-elementary significance is discussed. Also treated is the Justi-Kohler diagram, the Corbino effect, and the ratio of transversal and longitudinal effects. In connection with the free path of conductivity electrons, reference is made to reflections and new experiments on the appearance of a surface ohmic resistance in a monocrystal of Au, extremely pure and cooled to a very low temperature. The effects of trace impurities and deformations on the ideal resistance is discussed. References are included on the perfecting of the residual-resistance formula of Mattheissen-Nernst using the Kohler principle of minimal entropy increase, and experimental confirmations of the Mattheissen-Kohler formula are offered. Thermal conductivity of pure or almost pure metals is discussed. The possibility of extending the Grüneisen law on electric resistivity to thermal resistance is examined, and the Kohler law is explained. 78 references. (T.R.H.)

21158 (JPRS-9175) THE RARE-EARTH METALS AND PROSPECTS OF THEIR INDUSTRIAL USE. E. (Ye.) M. Savitskii (Savitskiy). Translated from Vestnik Akad. Nauk S.S.S.R., 30: No. 6, 81-8(1960). 14p.

A review of the properties and uses of rare earth elements is presented. Phase studies are included along with information on alloying. (J.R.D.)

21159 (JPRS-9220) PLASTIC DEFORMATION OF METALS. Sergei Ivanovich Gubkin. Translation of "Plasticheskaya Deformatisiya Metallov." Vol. II, 1960. (A Publication of the State Scientific-Technical Publishing House for Literature on Ferrous and Nonferrous Metallurgy, Moscow, 1960). 416p.

The fundamentals of the physico-chemical theory of plasticity are presented. The distinguishing features of the various plastic-deformation mechanisms of mono- and polycrystalline bodies are described. The influence of various factors on plasticity and resistance to deformation in metals pressworking are examined on the basis of modern physical chemistry. The influence of contact friction on the plastic-deformation processes is discussed. (JPRS)

21160 (NP-tr-510(p.20-8)) INVESTIGATION OF TERNARY Mg–Th–Mn ALLOYS. M. E. (Ye.) Drits, M. V. Mal'tsev, E. (Ye.) M. Padezhnova, and G. M. Bordina. Issledovanie Splavov Tsvetnykh Metal., Akad. Nauk S.S.S.R., Inst. Met. im A. A. Baikova, No. 2, 114-21(1960).

Phase studies were conducted on a Mg–Mn–Th alloy (Th content of 1, 2, and 3%; Mn content of 0.5, 1, and 2%) at 200, 300, 400, 500, and 550°C. (C.J.G.)

21161 (NP-tr-510(p.29-38)) PROPERTIES OF BORIDE-BASE MATERIALS AND OTHER HIGH MELTING COMPOUNDS. K. I. Portnoy. Issledovanie Splavov Tsvetnykh Metal., Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, No. 2, 197-204(1960).

The high-temperature properties of boride-base materials and metal systems containing carbides and silicides are reviewed. (C.J.G.)

21162 (NP-tr-617) HARDNESS OF STEELS AND HARD ALLOYS AT ELEVATED TEMPERATURES. A. I. Betaneli. Translated from a publication of the State Publishing House of Scientific and Technical Literature on Machinery, Moscow, 1958. 98p.

Methods for determining the hardness of metals and alloys at high temperatures are reviewed. Results of determinations of the hardness of structural steels, tool steels, and high-speed steels, and hard cermets are presented together with analysis of the experimental data. (D.L.C.)

21163 (NP-tr-672) APPLICATION OF THE THEORY OF THERMODYNAMIC SIMILARITY TO DETERMINE THE PHYSICAL PROPERTIES OF HOT METAL (MOLTEN METALS). G. F. Butenko and M. I. Radchenko. Translated from Inzhener.-Fiz. Zhur., Akad, Nauk Belorus. S.S.R., 3: No. 6, 66-71(June 1960). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 20320.

21164 SELF DIFFUSION IN IRON. F. S. Buffington (California Inst. of Tech., Pasadena), K. Hirano, and M. Cohen. Acta Met., 9: 434-9(May 1961). (In English) (NYO-9428)

Self-diffusion in high-purity iron (99.97% Fe) is determined over the temperature range from 700 to 1436°C. The temperature dependence of the self-diffusion coefficient in face-centered cubic and in body-centered cubic iron can be expressed as follows (in cm^2/sec): gamma-iron, $D = 0.18 \exp(-64{,}500/RT)$; alpha-iron (paramagnetic), $D = 1.9 \exp(-57{,}200/RT)$; above 790°C; and alpha-iron (ferromagnetic), $D = 2.0 \exp(-60{,}000/RT)$; below 750°C. The diffusivity below the magnetic transformation is lower than expected from an extrapolation of the diffusion data for paramagnetic alpha-iron. (auth)

21165 DIFFUSION OF NICKEL INTO IRON. K. Hiran M. Cohen, and B. L. Averbach (Massachusetts Inst. of Tech., Cambridge, Mass.). Acta. Met., 9: 440-5(May 1961). (In English) (NYO-9427)

The diffusion of nickel into iron was measured in the temperature range 600 to 1050°C. Radioactive Ni^{63} was used as the tracer element; the surface-decrease and the tracer element; the surface-decrease and the residual-activity sectioning methods were employed. The diffusivit below the Curie temperature was observed to be lower tha that expected from an extrapolation of the diffusion data fo paramagnetic alpha-iron. The diffusion coefficients may b expressed as follows (in cm^2/sec): gamma-iron, $D = 0.77$ $\exp(-67{,}000/RT)$; paramagnetic alpha-iron above 800°C, $D = 1.3 \exp(-56{,}000/RT)$; and ferromagnetic alpha-iron below 680°C, $D = 1.4 \exp(-58{,}700/RT)$. The anomalous decrease in the diffusion coefficient starts at about 800°C, somewhat above the Curie temperature, and is thought to be associated with the effect of short range magnetic orde on the formation energy of vacancies. (auth)

21166 THE SOLUBILITY OF Ni, Cr, Fe, Ti, and Mo in LIQUID LITHIUM. H. W. Leavenworth and R. E. Cleary (Pratt and Whitney Aircraft-CANEL, Middletown, Conn.). Acta. Met., 9: 519-20(May 1961). (In English)

The solubilities of Cr, Fe, Mo, Ni, and Ti in liquid lithium as a function of temperature are determined between 200 and 1700°F. The results are graphically shown as a plot of the solubility, expressed as the atomic % of the solute versus the reciprocal of the absolute temperature. In addition to the effect that relative atomic size has on temperature coefficient of solubility, the data show that the magnitude of the solubility also increases with the atomic size. Nickel, chromium, and iron, having much smaller atomic diameters than molybdenum and titanium, have conversely much greater solubilities in lithium. (N.W.R.)

21167 SOME INTERMETALLIC AND SEMIMETALLIC COMPOUNDS OF GADOLINIUM. Aldo Iandelli (Università, Genoa, Italy). Atti acad. nazl. Lincei. Rend., Classe sci. fis., mat. e. nat., 29: 62-9(July-Aug. 1960). (In Italian)

Intermetallic compounds of Gd with the formula MX (X is Ag, Mg, Zn, Cd, and Hg) and MX_3 (X is In, Tl, and Sb) and semimetallic compounds with the formula MX (X is S, Se, Te, P, As, Sb, and Bi) were prepared and their structures were determined. The methods of preparation are described. (J.S.R.)

21168 PHYSICAL PROPERTIES OF NUCLEAR GRAPHITE. M. Bocquet and J. Rappeneau. Bull. inform. sci. et tech. (Paris), No. 48, 12-24(Feb. 1961). (In French)

A knowledge of the physical properties of graphite is necessary for the design and the calculation of reactor piling. But artificial graphite fabricated by spinning is an inhomogeneous and anisotropic solid whose properties depend on the base materials and on the fabrication procedure. After a review of the difficulties found in determining significant mean values of different physical characteristics, the measurement methods used and the results obtained are described. The physical properties studied are the apparent and the real densities, thermal expansion, electrical resistance, mechanical properties (hardness, compression strength, tensile strength, and bend strength), thermal conductivity, porosity, and gas permeability. For each physical characteristic studied, the results of the various measurement methods show the complexity of the material. The correlations existing between some physical magnitudes are indicated, and the effect of different fabrication parameters on the physical properties of the graphite is emphasized. (tr-auth)

21169 CERAMIC FUELS. A. Accary and E. Delmas. Bull. inform. sci. et tech. (Paris), No. 49, 2-18(Mar. 1961). (In French)

A study of uranium dioxide and uranium monocarbide is presented. The production and sintering of uranium dioxide and the problems connected with the production of high-density uranium oxide are studied. Some physico-chemical properties of the dioxide are reviewed with respect to the sintering process. The properties of the final products, in particular behavior under irradiation, are described. The application of sintering processes to the production of uranium carbide is described. Some properties of importance with respect to its use as a nuclear fuel, such as thermal conductivity, behavior toward carbon, uranium, and other metals, and the effect of neutron flux, are reported. Possible methods of industrial production are also considered. (auth)

21170 STUDY OF NUCLEAR MATERIALS BY THE EUTROCRYSTALLOGRAPHIC METHOD. J. Laniesse, M. Englander, and P. Meril. Bull. inform. sci. et tech. (Paris), No. 49, 69-79(Mar. 1961). (In French)

The advantages presented by neutrocrystallographic methods in determining the physical characteristics of nuclear materials are emphasized. The use of slow neutron beams, as intense and monoenergetic as possible, permits the obtention, more rapidly and statistically than by x-ray diffraction, of information on the texture of polycrystalline aggregates and on the evolution of crystal structures during solid state transformations. With this method it was possible to determine the preferential orientation existing in a fuel rod in pure or low-alloyed uranium and its evolution with respect to thermal treatments. The crystalline allotropic transformation $U\beta \rightarrow U\alpha$ was also followed as a function of time and temperature by continuously recording the intensity of a mixed diffraction line judiciously located with respect to α and β spectral lines. These data make possible a determination of the conditions ensuring good radiation stability of uranium fuels and the quantitative interpretation of the kinetics of the transformations in the solid state which also affect stability. (auth)

21171 PRECIPITATION HARDENING OF Co-BASE ALLOYS BY MEANS OF AN INTERMETALLIC Co-Mo PHASE. B. Lux and W. Bollmann (Battelle Memorial Inst., Columbus, Ohio). Cobalt, No. 11: 4-20(June 1961).

The possibility of precipitation hardening Co–Cr–Mo alloys by means of Co–Mo intermetallic compounds is examined. Chromium and molybdenum contents ranged from 12 to 17.5% and from 15 to 20%, respectively. Considerable hardening is observed within the first few hours of aging at 800 and 1000°C. Coherent or partially-coherent particles with a diameter of about 50 A are formed during the age-hardening process. It is not possible to determine whether these particles have the Co_3Mo or Co_7Mo_6 structure in the intermediate stages of precipitation. Fine hair cracks are detected in most alloys cast. Creep-rupture tests of 12Cr–17.5Mo–balance Co show that the rupture strength is similar to that of the commercial Ni-base alloy, Nimonic 95, in the 700 to 850°C range. Oxidation tests at 900°C show satisfactory up to 2000 hours. Its thermal shock resistance and forgeability are comparable with those of commerical high-temperature alloys. The advantage of these heat-resisting and reactive-free alloys is that they could be prepared without a vacuum. (N.W.R.)

21172 OBSERVATIONS ON THE TORSION DEFORMATION OF ALUMINUM AND COPPER AT HIGH TEMPERATURES. Donald Hardwick, W. J. McGregor Tegart, Claude Rossard, and Paul Blain (Univ. of Sheffield, Eng. and Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye, France). Compt. rend., 252: 2881-3(May 8, 1961). (In French)

Some torsion tests on aluminum and copper show a marked difference in the behavior of these metals to hot deformation. The evolution of the structure accompanying the deformation is produced for aluminum by evolution between the work-hardening and formation of subgrains. For copper it is produced by evolution between work-hardening and recrystallization. (tr-auth)

21173 THE INTERSECTION OF STABLE AND NON-EQUILIBRIUM TETRAHEDRA IN A MUTUAL 7-COMPONENT SYSTEM OF Li, Na, Rb, Tl/Br, Cl, NO_3, SO_4. N. S. Dombrovskaya, N. V. Khakhlova, and E. A. Alekseeva (All-Union Scientific Research and Construction Inst. of Chemical Equipment, USSR). Doklady Akad. Nauk S.S.S.R., 137: 1361-3(Apr. 21, 1961). (In Russian)

The most stable configuration of the mixture of the 16 salts formed from Li, Na, Rb, Tl/Br, Cl, NO_3, and SO_4 con-

sists of the basic tetrahedron of $LiSO_4-NaCl-RbNO_3-TlBr$, while the most reactive salts form a non-equilibrium mixture which however interact, resulting in a stable mixture. On the basis of exchange reactions the following equation has been derived: $LiBr + NaNO_3 + RbCl + \frac{1}{2}Tl_2SO_4 = \frac{1}{2}LiSO_4 + NaCl + RbNO_3 + TlBr$. In addition, several binary complexes are also formed, such as $Li_2SO_4 \cdot Rb_2SO_4$, $4Li_2SO_4 \cdot RbSO_4$, $RbCl \cdot 2Li_2SO_4$ and possible others. In view of the great interest, the intersection of stable and non-equilibrium tetrahedra consisting of components of both, was experimentally studied by thermal analysis. On the basis of cooling curves the following deflection points have been observed: 453°C, precipitation of the first Li_2SO_4 crystals; 409°, coprecipitation of Li_2SO_4 and NaCl; 391°, coprecipitation of Li_2SO_4, NaCl and TlBr; and finally at 107°, formation of the quaternary eutectic with the previously mentioned salts + $RbNO_3$. The microstructures of the stable and non-equilibrium phases are quite similar. (TTT)

21174 DISLOCATION RELAXATION PHENOMENA IN OXIDE CRYSTALS. Roger Chang (Atomics International, Canoga Park, Calif.). J. Appl. Phys., 32: 1127-32(June 1961).

The dislocation relaxation of MgO and Al_2O_3 crystals was studied by means of anelastic measurements. The data were analyzed according to the theory of Seeger, Donth, and Pfaff. It was shown that the ratio of Peierls force to shear modulus was about 2×10^{-5} for MgO and possibly also for Al_2O_3. Comparison of the dislocation relaxation phenomena of oxides and metals indicated that the ratio of Peierls force to shear modulus in oxides was about an order of magnitude smaller than that in fcc metals. (auth)

21175 ON THE THERMIONIC PROPERTIES OF ZrC, UC, AND A ZrC·UC MIXTURE. W. E. Danforth and Albert J. Williams, III (Bartol Research Foundation of the Franklin Inst., Swarthmore, Penna.). J. Appl. Phys., 32: 1181-2(June 1961).

The thermionic properties of UC, ZrC, and a UC-4ZrC mixture are reported from about 1200 to about 2000°K. The samples are in the form of pellets. The values of A and ϕ in Richardson's equation are found for the samples. (T.F.H.)

21176 FIELD EMISSION FROM WHISKERS. A. J. Melmed and R. Gomer (Univ. of Chicago). J. Chem. Phys., 34: 1802-12(May 1961).

A method for obtaining field emission from whiskers grown in situ from the vapor under high-vacuum conditions is described. It is possible using this method to fabricate clean and strong emitters from almost any conducting material, so that the range of substances that can be used for field emission is expanded. Electrical methods for following the growth kinetics and determining whisker length and radius are described and applied to Au. Growth is found to be positively exponential with time, which suggests a mechanism of growth by diffusion of impinging atoms over the whisker sides and incorporation at the growing end. Cessation of growth is diffusion limited. It is possible to estimate the activation energy for the surface diffusion of Au on Au as 23 ± 5 kcal from the variation of terminal length with temperature. Some adsorption and oxidation experiments indicate that the method can also be used for the study of these phenomena. It is found, for instance, that H_2 is not adsorbed on Au and that Al is oxidized with severe surface rearrangement even at 77°K. (auth)

21177 OXYGEN UPTAKE ON REACTOR-GRADE ZIRCONIUM IN INCANDESCENCE IN AIR. G. Saur, H.-J. Laue, and H. Borchers (Technische Hochschule, Munich). Metall, 15: 409(May 1961). (In German)

The oxygen uptake of zirconium in air at temperatures under 900°C, after more than 16 hr incandescence time, is limited to a slight boundary zone and does not disturb investigations of the effects of heat treatment on the structure. A simplification of the research method, in the cooling, was attained. A minimum thickness of the samples is necessary. (tr-auth)

21178 SINTERED ALUMINIUM POWDER AS A CANNING MATERIAL. C. Bridoux, J. Kauffman, P. Thome, and H. Foulquier (Commissariat a l'Energie Atomique, [Paris]. Nuclear Eng., 6: No. 60, 189-92(May 1961).

The equipment and conditions necessary for the welding of sintered aluminum powder (SAP) is described. The welding processes described are forge, ultrasonic, and flash welding. The possible use of SAP as a canning material in organic-cooled reactors is discussed and it is shown that the material is comparable to beryllium over the temperature range 400 to 500°C. Fatigue, tensile, stress, and creep curves are shown for the welded specimen. (N.W.R.)

21179 CERAMICS—PROPERTIES. G. Arthur (Parsons Nuclear Research Centre). Nuclear Eng., 6: 253-7(June 1, 1961).

Ceramics that have applications in reactor design are studied. Oxides studied include BeO, MgO, Al_2O_3, ZrO_2, $MgO \cdot Al_2O_3$, $3Al_2O_3 \cdot 2SiO_2$, SiO_2, TiO_2, Sm_2O_3, Eu_2O_3, Gd_2O_3, Dy_2O_3, ThO_2, UO_2, and PuO_2. Carbides studied include graphite, SiC, TiC, ZrC, B_4C, HfC, and UC. Silicide and nitrides studied comprise U_3Si, U_3Si_2, Si_3N_4, and BN. The thermal expansion strength; and rupture, elastic and Young's moduli for the ceramics are detailed. Effects of anisotropy, porosity, and grain size are taken into account. (T.F.H.)

21180 SUPERCONDUCTIVITY OF Nb_3Sn IN A PULSED MAGNETIC FIELD. J. O. Betterton, Jr., R. W. Boom, G. D. Kneip, and R. E. Worsham (Oak Ridge National Lab, Tenn.). Phys. Rev. Letters, 6: 532-4(May 15, 1961).

The critical current of Nb_3Sn wires clad in Nb is measured at 4.2°K and at 0 to 130 kgauss. The effects of both longitudinal and transverse magnetic fields are studied. The magnetic field is pulsed, and current pulses of 30 to 150 μsec are passed through the sample at the peak of the magnetic field pulses. The superconducting-normal transition time and the sample resistance are also measured. (T.F.H.)

21181 MAGNETIC COOLING WITH PARAMAGNETIC METALS. R. D. Parks and W. A. Little (Stanford Univ., Calif.). Phys. Rev. Letters, 6: 539-41(May 15, 1961).

The magnetic properties of Er-Th alloys below 1°K are studied. Er concentrations of 0.82 to 9.6% are used. Magnetic cooling curves are given from 0.73°K as a function of the change in the magnetic field. Temperatures as low as 0.07°K are reached. The cooling efficiency of the Er-alloys is compared with that of paramagnetic salts. (T.F.H.)

21182 ISOTHERMAL TRANSFORMATION OF U-14 AND U-16 WEIGHT PERCENT MOLYBDENUM ALLOYS AT 550°C. W. A. Holland (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 93 (June 1961).

21183 FURTHER STUDIES ON THE DEFORMATION OF THIN CLADDING BY UO_2 THERMAL EXPANSION. M. F. Lyons (General Electric Co., Pleasanton or San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 148-9 (June 1961).

21184 EFFECT OF OXYGEN ON THE PROPERTIES OF ZIRCALOY-2. L. S. Rubenstein, J. G. Goodwin, and F. L. Shubert (Westinghouse Electric Corp., Pittsburgh). Trans. Quart., 54: No. 1, 20-30(Mar. 1961). (WAPD-T-1074)

The results of an experiment to determine the effect of 100 to 10000 ppm oxygen on the tensile strength, hardness, hot and cold fabricability, corrosion resistance in 680°F water and in 750°F, 1500 psi steam, and on the microstructural and phase transformation temperature limit changes of Zircaloy-2 are discussed. It is shown that oxygen effectively raises the 0.2% yield and tensile strengths, decreases the corrosion resistance of Zircaloy-2 at contents in excess of 2000 ppm, raises the alpha to alpha + beta transus and displays a strong hardening effect which increases linearly with the square root of oxygen content. (auth)

21185 BORON AND ITS COMPOUNDS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 23p. (SB-456) $0.10(OTS) Supplement to CTR-303.

Four hundred and seventy reports on boron added to the OTS collection from 1957 to May 1961 are listed. Included are reports and translations on boron metals, alloys, compounds, and toxic effects of boron. (M.C.G.)

21186 COBALT. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 13p. (SB-457) $0.10(OTS) Supplement to CTR-323.

One hundred and sixty five PB reports, AEC reports, and translations on cobalt, its alloys, and compounds added to the OTS collection during the period 1956 to April 1961 are listed. (M.C.G.)

21187 QUANTITATIVE PHASE ANALYSIS OF "KOVAR"-ALLOYS BY MEANS OF X-RAYS. Alexander Spirkov. p.274-86 of "Sborník Prací Elektrovakuoveho Oboru. Č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

By means of a modified Averbach-Cohen method the temperature factor and other properties of kovar (51 to 54% Fe, 27 to 30% Ni, 17 to 20% Co) are found, and the α and γ phases are quantitatively determined. From the results, a method is deduced for estimating the sealing properties of a given kovar sample. (auth)

21188 VITROUS PRODUCTS FOR USE IN NUCLEAR REACTORS. (to Compagnie Saint-Gobain). Belgian Patent 585,959. Priority date, Dec. 30, 1958.

Very small uranium-bearing glass granules are used as fuel in homogeneous, heavy water moderated reactors. A typical composition is: 30% UO_2, 30% SiO_2, 7% TiO_2, 7% ZrO_2, 12% CaO, 8.5% ZnO, 3% MgO, and 2.5% BeO. The granules are coated with a surface layer of magnesium silicate by a 100 to 150 hour treatment with $MgCl_2$ at 100°C. The heavy water moderator surrounding the granules contains a small amount of silica gel or of magnesium or beryllium salts or hydroxides which considerably reduces the corrosion of the glass. (EURATOM)

21189 STRUCTURAL STEEL FOR NUCLEAR REACTORS. E. J. Kirschning (to Klöckner-Duisburg). Belgian Patent 595,243. Priority date, Oct. 22, 1959.

For reduced sensitivity to irradiation, 18 to 24% Cr, 8 to 12% Ni, and 0.0001 to 0.5% of a rare earth metal, such as Ce, Pr, and/or Nd, preferably 0.08% Ce, are added to austenitic stainless steel. (EURATOM)

21190 PROCESS FOR THE PRODUCTION OF TERPHENYLS. (to Montecatini Societa Generale per l'Industria Mineraria e Chimica). British Patent 865,302. Apr. 12, 1961.

A process for the production of terphenyls by pyrolysis of benzene, in which the benzene contains a minor proportion of diphenyl by weight, is described. The pyrolysis is carried out within a temperature range of 750 to 850°C using from 5 to 20% diphenyl but by employing greater amounts of diphenyl, particularly from 20 to 30%, it is possible to obtain a process in which only terphenyls and heavier products are obtained. The quantity of diphenyl at the outlet of the tube remains almost equal to the quantity of diphenyl introduced at the inlet diluted in benzene. The addition of products heavier than terphenyls can bring about better yields both in diphenyl and in terphenyl and therefore one can add to the benzene as well as diphenyl a minor amount of polyphenyls particularly from 1 to 5%. The mixture of terphenyls produced by the process of the invention can be used in nuclear power plants as a heat transfer and a neutron moderator fluid. Such a fluid can contain up to 50% diphenyl. (N.W.R.)

21191 A METHOD OF MANUFACTURE OF AN ALUMINIUM ALLOY AND THE ALLOY OBTAINED BY THIS PROCESS. (to Commissariat a l'Energie Atomique). British Patent 868,769. May 25, 1961.

A method of manufacture of aluminum alloys which are corrosion resistant to water under pressure and at high temperatures and includes iron and/or nickel is described. The alloyed granules contain between 0.05 and 4% iron or nickel or both. The granules are compressed to form an alloyed mass. The mass is extruded to produce a shearing effect adjacent to the surface. Through these two processes the added metals form an even distribution and fine dispersion in the aluminum. The granules are distinguished in that they are subjected to heat treatment in order to ensure an intermetallic diffusion. The granules have a silicon content lower than 0.01%, and contents in each of zinc, manganese, and magnesium lower than 0.005%, and of copper lower than 0.01%. The shearing is obtained by deviations and constrictions caused in the overflow in the vicinity of the drawing-plate of the extrusion apparatus. The granules are of the 300 microns size. (N.W.R.)

21192 IMPROVEMENTS IN OR RELATING TO NIOBIUM-BASE ALLOYS. (to E. I. du Pont de Nemours and Co.). British Patent 869,629. May 31, 1961.

The preparation and properties of oxidation-resistant niobium-base alloys which are adapted to withstand prolonged exposure at 800°C and above are described. The alloys consist of 55 to 80% by weight niobium, 1 to 20% aluminum, 1 to 30% chromium, and in combination therewith a total of 0 to 35% of one or more of cobalt, nickel, tungsten, and zirconium; 0 to 5% of beryllium, manganese, silicon, thorium, and vanadium, the total of this group not to exceed 15%; and one or more of boron, carbon, calcium, and cerium in the range 0 to 2%, the total not to exceed 5% of this group. (N.W.R.)

21193 NIOBIUM-BASE ALLOYS. (to E. I. du Pont de Nemours and Co.). British Patent 869,817. June 7, 1961.

The preparation and properties of aluminum-iron-niobium alloys are described. The alloys exhibit unusual strength and oxidation resistance under extreme high-temperature service conditions. The niobium-base alloys consist essentially of at least 55% by weight of niobium, 1 to 20% aluminum, and 1 to 20% iron, and optionally containing 0 to 35% cobalt, nickel, tungsten, and zirconium, 0 to 5% of one or more of beryllium, manganese, molybdenum, silicon, thorium, and vanadium, the total of this group not to exceed 15%, and 0 to 2% of one or more of boron, carbon, calcium, and cerium, the total of this group not to exceed 5%, and the normal impurities. (N.W.R.)

21194 NIOBIUM-BASE ALLOYS. (to E. I. du Pont de Nemours and Co.). British Patent 869,937. June 7, 1961.

Preparation and properties of niobium alloys which exhibit unusual strength and oxidation resistance under extreme high-temperature service conditions are discussed. The niobium-molybdenum alloys contain varying amounts of one or more of the elements of the group comprising iron, chromium, cobalt, nickel, tungsten, and zirconium plus the normal impurities. The alloys contain at least 55% by weight of niobium, 1 to 20% molybdenum, 1 to 30% of the above mentioned elements, 0 to 5% of beryllium, manganese, silicon, thorium, or vanadium, and 0 to 2% boron, carbon, calcium or cerium plus the normal impurities. (N.W.R.)

Radiation Effects

21195 (AD-251543) EFFECT OF RADIATION ON CAN ENAMELS. Report No. 10 (Progress), October 29, 1959–January 28, 1960. G. B. Pratt (American Can Co., Barrington, Ill.). Contract DA19-129-QM-968. 14p.

Can enamels which were found to be satisfactory for irradiated foods after 1 year at 98°F are given. The enamels giving satisfactory performance for all irradiated products are oleoresinous, epoxy-phenolic, and polybutadiene. Vacuum loss studies revealed that all irradiated products lost considerable vacuum during irradiation and that radioinduced gas production overshadows gas production by corrosion. (D.L.C.)

21196 (BMI-1516) IRRADIATION-CAPSULE STUDY FOR SM-2 REFERENCE AND ALTERNATE DISPERSION FUELS. David B. Hamilton, John F. Lagedrost, Eugene M. Simons, and John H. Stang (Battelle Memorial Inst., Columbus, Ohio). May 25, 1961. Contract W-7405-eng-92. 49p.

Nominal 24 to 40 wt.% highly enriched UO_2 dispersed in a matrix of Type 347 stainless steel, with burnable poisons in the form of B_4C, ZrB_2, NbB_2, or boron-10, and clad with Type 347 stainless steel are being evaluated for the SM-2 by capsule irradiation in high-flux positions at the MTR and the ETR. Each capsule contains five to eight specimens to be irradiated to nominal burnups of 37 to 70 at.% of the uranium-235 at surface temperatures near 600°F. The plate-type specimens are supported between OFHC copper semicylinders which are wrapped with sheathed electric heaters having a total capacity of 12 kw and are immersed in NaK in single-wall nickel capsules. Thermocouples are located adjacent to specimen surfaces. Irradiations of four capsules were completed early in 1960; maximum specimen burnups were approximately 40 per cent of the total uranium atoms originally present. Temperature data from six current in-pile capsules indicate that the majority of the specimens now being irradiated are close to design temperature. Estimates of current burnup levels include consideration of specific uncertainties involved in the calculations and the measured burnup of specimens from the first capsules. (auth)

21197 (NARF-61-6T) THE EFFECTS OF REACTOR RADIATION ON ELASTOMERS AND SEALANTS. [PART] IV. L. L. Morgan (Convair, Fort Worth, Tex.). May 9, 1961. Contract AF33(600)-38946. 46p. (MR-N-174-4)

Polyurethane elastomers are produced through the reaction of certain diisocyanates and polyhydroxy compounds (polyesters and polyethers). Most of the commercial materials have a relatively high aromatic content. Thirteen polyurethane elastomers from three manufacturers were irradiated to various doses at several temperatures. The highest dose was 7×10^{10} ergs/gm(C) gamma plus accompanying neutrons. The irradiation temperatures ranged from −45 to 260°F in various combinations with dose. Following irradiation, stress-strain measurements were made on all of the materials. Compression-set tests were performed on certain selected elastomers. The data tend to indicate that materials from any particular manufacturer were sufficiently similar so that their percentage change from control values were of the same order of magnitude under the same conditions. (auth)

21198 (NP-10159) EVALUATION–DEVELOPMENT OF MIL-C-14157 CAPACITORS FOR NUCLEAR RADIATION ENVIRONMENT. Scientific Report No. 7. (Admiral Corp., Chicago). May 1961. Contract Nobsr-77612. 32p.

Six E-200 capacitors that survived gamma irradiation were subjected to environmental tests. Two units survived the tests. Half of the units in the control test failed within two hours. All of the inhibited oversized monoisopropylbiphenyl units failed in the gamma-temperature environment; however, they survived longer than the standard CPM08 capacitors. Some isocyanate-treated Mylar and the Samica units were received and testing begun. (auth)

21199 (NP-10229(p.103-11)) RADIATION EFFECTS ON AIRCRAFT TURBINE LUBRICANTS. F. A. Haley (Convair, Fort Worth, Tex.).

Samples of three aircraft turbine engine lubricants, MIL-L-7808, MIL-L-9236, and GTO-790 (complex ester), were irradiated in a dynamic test loop in the Ground Test Reactor flux for ~20 hr. A common dose rate of 4.1×10^8 ergs/g(C)/hr and 8.1×10^9 neutrons/cm^2/sec (energies above 2.9 Mev) was maintained. Test samples were withdrawn every 2 hr during irradiation and oil properties measured. The data are presented and comparisons made of the radiation resistance of the three oils. (D.L.C.)

21200 (NP-10232) TRANSIENT EFFECTS OF NUCLEAR RADIATION ON ELECTRONIC PARTS AND CIRCUITS, FIRST EXPERIMENT. Bernard J. Stralser (Navy Electronics Lab., San Diego, Calif.). Sept. 9, 1958. 23p. (TM-301).

An effects type of experiment was performed which indicated that when a transistor bi-stable multi-vibrator (flip-flop) circuit is exposed to a pulse of ionizing radiation, the flip-flop is caused to change state. This was a transient effect. The circuit functioned normally after exposure, and so there appeared to be no permanent damage to the parts of the circuit. Under test conditions, the minimum dose which caused this effect was found to be approximately 0.65 rad/pulse at a dose rate of about 5×10^4 rad/sec. The threshold for switching was not determined. (auth)

21201 (NP-10234) RADIATION DAMAGE TO PLASTICS. Summary Report. Edward Gerjuoy, Olen Nance, and Horace A. Ory (Plesset (E. H.) Associates, Inc., Los Angeles). Mar. 1961. Contract AF29(601)-1897. 65p. (TR-108)

The basic phenomena involved in radiation damage to plastics are reviewed and interpreted in terms of modified responses of irradiated plastics to subsequent stresses. The topics considered include: mode of energy deposition and partition between thermal and specific effects; primary physical processes involved in ionization, electronic excitation, and bond rupture; types of species produced and their chemical behavior; structural changes resulting from induced chemical reactions; and the evaluation of radiation damage as reflected by variation of electrical, thermal, and mechanical parameters of materials with radiation dose. (91 references.) (auth)

21202 (ORNL-3108) THE CARRIER-RECOMBINATION BEHAVIOR AND ANNEALING PROPERTIES OF RADIATION

INDUCED RECOMBINATION CENTERS IN GERMANIUM. O. L. Curtis, Jr. and J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). June 1, 1961. Contract W-7405-eng-26. 116p.

Thesis submitted to the Univ. of Tennessee.

Carrier recombination and annealing of radioinduced recombination centers were investigated for both n- and p-type Ge. The experimental results are explained by a model in which recombination occurs at 0.36 ev above the valence band in γ-irradiated, n-type Ge; the position of this level is shifted slightly downward for neutron-irradiated Ge. Trapping levels occur in As-doped Ge (at 0.17 ev above the valence band) which are not present in Sb-doped Ge. For p-type Ge, an energy level present in unirradiated Ge acts as a trapping center. A value for the electron capture cross section of n-type Ge is derived: 7×10^{-19} cm^2. The annealing properties of Sb- and As-doped Ge are very different. A model for the annealing results is given in which irradiation produces three major types of defects: interstitials, vacancies, and vacancy-interstitial pairs. The properties of each defect type are described. Association of vacancies with doping atoms is discussed. (D.L.C.)

21203 (PAN-201/I-B) THE EFFECT OF REACTOR FAST NEUTRONS ON ELECTRON-HOLE RECOMBINATION IN GERMANIUM. A. Czachor and Piekoszewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 12p.

The properties of recombination centers introduced by fast neutrons in n-type germanium were investigated. From carrier lifetime temperature measurements, using Shockley-Read statistics, recombination level position was calculated and found to be dependent on resistivity of germanium. It was observed that in the region of low temperatures, lifetime increases with decreasing temperature. (auth)

21204 (REIC-17) THE EFFECT OF NUCLEAR RADIATION ON STRUCTURAL ADHESIVES. N. J. Broadway and S. Palinchak (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 1, 1961. Contract AF33(616)-7375. 56p.

A discussion is given of the state of the art on the effects of radiation on adhesives. The radiation-effects information published up to 1961 for various adhesives based on organic materials is summarized. The information presented is largely for structural adhesives, since most radiation-effects studies were on these types. With a few exceptions, the radiation stability on nonstructural adhesives was not determined. (auth)

21205 (USASRDL-TR-2149) EFFECTS OF IRRADIATION AND THERMAL TREATMENT ON THE DIELECTRIC DISPERSIONS IN NYLON. Marvin N. Stein (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Nov. 1960. 92p.

The effect of irradiation and thermal treatment on the dielectric properties of several long-chain polymers was studied in the temperature region from −160 to +80°C for frequencies from 0.1 to 100 kc. The dielectric data show one or more dispersion regions which were correlated with the onset of various modes of internal motion within the polymers. The changes in dielectric properties are interpreted in terms of the alteration in structure produced by irradiation, absorbed moisture, and thermal treatment. The concept of radiation damage as a thermal spike phenomenon is introduced to explain the similar results produced by thermal quenching and irradiation. The two low-temperature dispersion regions in nylon were studied extensively and are discussed in detail. (auth)

21206 (USASRDL-TR-2153) NUCLEAR RADIATION EFFECTS ON THE COLD CATHODE-TYPE ELECTRON TUBE AT THE CURTISS-WRIGHT FIVE-MEGAWATT RESEARCH REACTOR. Richard G. Saelens (Army Signal Research and Development Lab., Fort Monmouth). Dec. 1960. 16p. (AD-251147)

Six MgO cold cathode-type electron tubes were exposed to a total integrated fast neutron dose of approximately 5×10^{16} n/cm^2. The a-c output of four tubes was monitored continuously on a cathode ray oscilloscope, and certain d-c parameters recorded periodically. Two tubes were exposed statically. Three of the four cold cathode tubes which were operating displayed a large signal degradation after approximately 23 hours in the radiation environment; the fourth tube was operating at approximately the original signal level upon completion of the test. With voltages applied to the plate and sustaining grid (starter filament not energized), the cold cathode tube began operating when exposed to the nuclear radiation. (auth)

21207 DISCUSSION OF "IRRADIATION HARDENING IN COPPER AND NICKEL". J. D. Meakin (Univ. of Durham, Newcastle-upon-Tyne, Eng.). Acta Met., 9: 521-2(May 1961).

Direct evidence that the value of σ_i determined by extrapolation differs considerably from that obtained by determining σ_{LYP} as a function of grain size is discussed. Possible causes for the differences in the derived values of σ_i and K_Y are suggested. It is also shown that the value of σ_i determined by Makin and Minter is incorrect. (N.W.R.)

21208 EFFECTS OF RADIATION ON GRAPHITE REACTORS. J. Rappeneau. Bull. inform. sci. et tech. (Paris), No. 48, 25-36(Feb. 1961). (In French)

All the physical properties of graphite undergo marked changes under the effect of reactor radiation. To study these modifications irradiation programs were developed. These programs, in which a large number of samples are studied in order to take into consideration the anisotropy of the heterogeneity and the fabrication variables, are briefly reviewed. Along with the irradiation programs, methods for the study of the physical properties were developed. These study methods and the results obtained on some industrial graphites are described. The internal energy stored by the graphite under radiation, the dimensional stability, and the modifications in the thermal conductivity and mechanical characteristics were studied with emphasis on recovery. A study of radioinduced variations in thermal expansion, electric resistivity, and crystal parameters was also made. The results obtained give a knowledge of the behavior of irradiated graphite at temperatures from 80 to 450°C. (tr-auth)

21209 PROTECTION AGAINST RADIATION DAMAGE IN POLYMETHYLMETHACRYLATE BY HIGH-ENERGY ELECTRONS AND BY ULTRAVIOLET LIGHT. Donald G. Gardner (Univ. of Arkansas, Fayetteville) and Lawrence M. Epstein. J. Chem. Phys., 34: 1653-60(May 1961).

Polymethylmethacrylate may be protected against damage caused by ultraviolet light and 2 Mev electrons by small amounts of such additives as pyrene, p-terphenyl, xylene, benzene, and lead stearate. The protective properties are discussed in terms of a model involving energy transport by both excited and ionized states. (auth)

21210 OBSERVATION OF LATTICE DEFECTS IN FISSION FRAGMENT-IRRADIATED GRAPHITE. Kazuhiko Izui and F. Eiichi Fujita (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 16: 1032-3(May 1961).

Some electron microscopic observations of large defects

in graphite induced by fission fragment irradiation are shown. The observations were done on refined natural graphite powder mixed with uranium oxide powder in the ratio 10:1. The material was exposed to thermal neutrons in a reactor to total doses of the order of 10^{16} n/cm^2. Tracks of fission fragments from U^{235} are sometimes observed as straight lines about 100 A wide accompanied by small dots. By tilting the specimen, their contrasts turn from black to white as the matrix changes from white to black. This indicates that the tracks are essentially the diffraction contrasts caused by variations in the Bragg conditions in the crystal and that these narrow linear regions have a crystallographic nature or orientation slightly different from the matrix, possibly exhibiting the thermal spike effect of fission fragments passing through the crystal. Dislocation lines are also partly due to absorbtion of interstitial atoms produced by the irradiation. (N.W.R.)

21211 EFFECT OF IRRADIATION WITH FAST NEUTRONS ON THE PHOSPHOR ZnS–Mn. P. Jaszczyn (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk, Poland). Phys. and Chem. Solids, 19: 299-303(May 1961). (In French)

The ZnS (Mn) phosphor is irradiated with fast neutrons. The influence on the blue and orange luminescent bands is studied. (auth)

21212 EVIDENCE FOR FOCUSING COLLISIONS IN IRRADIATED PLATINUM. E. Ruedl, P. Delavignette, and S. Amelinckx (Centre D'Etude de l'Energie Nucleaire, Mol, Belg.). Phys. Rev. Letters, 6: 530-2(May 15, 1961).

Foils of Pt 0.1 μ thick are annealed at 800°C and exposed to various fission fragment doses. Electron microscope examination of the foils after irradiation reveals that defects are formed preferentially along coherent twin boundaries, but not along ordinary boundaries. It is concluded that the twin boundary acts as a barrier to focused collisions, such that focused collisions along the <110>, <100>, or <111> directions, upon arriving at the boundary, are changed into nonfocusing collisions. Point defects are formed when this change occurs. Factors influencing this effect, such as foil thickness, are noted. (T.F.H.)

21213 COMPARISON OF TRANSIENT EFFECTS IN ELECTRONICS OBTAINED WITH DIFFERENT NUCLEAR PULSES. P. R. Arendt (U. S. Army Signal Corps, Fort Monmouth, N. J.). Trans. Am. Nuclear Soc., 4: No. 1, 27-8(June 1961).

21214 IN-PILE LOOP IRRADIATION OF AQUEOUS THORIA-URANIA SLURRY. E. L. Compere, H. C. Savage, A. J. Shor, V. A. DeCarlo, J. M. Baker, and D. T. Jones (Oak Ridge National Lab., Tenn.). Trans. Am. Nuclear Soc., 4: No. 1, 57(June 1961).

21215 IN-PILE TEST OF A CERAMIC CORE FUEL ELEMENT FOR THE ML-1 REACTOR. L. W. Weisbecker (Aerojet General Nucleonics, San Ramon, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 58(June 1961).

21216 RESULTS OF CAROLINAS-VIRGINIA TEST REACTOR ROTATING RABBIT CAPSULE IRRADIATION EXPERIMENTS. R. N. Duncan (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 58-60 (June 1961).

21217 IN-PILE FISSION GAS RELEASE BEHAVIOR OF ALUMINA COATED UO_2 PARTICLES. G. E. Raines, C. W. Townley, S. D. Beck, and W. H. Goldthwaite (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Nuclear Soc., 4: No. 1, 60(June 1961).

21218 RADIATION DAMAGE TO UNIPOLAR TRANSISTORS. R. V. Babcock (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 60-1(June 1961).

21219 MEASUREMENT AND INTERPRETATION OF DYNAMIC VOID GROWTH IN HOMOGENEOUS FISSILE SOLUTIONS. C. Bumpus, P. Spiegler, and A. Norman (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 71(June 1961).

21220 NEUTRON-INDUCED CHANGES IN NOTCH DUCTILITY OF REACTOR PRESSURE VESSEL STEELS. L. E. Steele and J. R. Hawthorne (U. S. Naval Research Lab., Washington, D. C.). Trans. Am. Nuclear Soc., 4: No. 1, 92-3(June 1961).

21221 THE DEVELOPMENT OF CRYSTALLINITY AND TRANSPARENCY IN IRRADIATED POLYETHYLENE. B. Levy (Westinghouse Electric Corp., East Pittsburgh, Penna.). Trans. Am. Nuclear Soc., 4: No. 1, 124(June 1961).

21222 ANISOTROPY OF HYPERFINE SPLITTING IN ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF IRRADIATED ORIENTED POLYMERS. A. G. Kiselev, M. A. Mokul'skii, and Yu. S. Lazurkin. Vysokomolekularnye Soedineniya, 2: 1678-87(1960). (In Russian)

Radicals forming on the irradiation of polymers were identified by the hyperfine structure of the epr spectrum. Experiments were made by stretching oriented polymers. The epr spectra were taken at various angles between orientation of the polymer and the magnetic field at 9000 Mc/sec in the high-frequency modulated magnetic field. The investigation covered low-pressure polyethylene stretched in the cold state; polytetrafluoroethylene (Teflon), stretched at 300°C; polyvinyl chloride stretched at 72°C; and polymethylmethacrylate stretched at 140°C. Irradiation took place either in the reactor (in evacuated quartz ampules at 40 to 50°C) or by β radiation from a Au^{198} needle (half life 64.6 hr). It is shown that the intensities of the lines and their number depend, in polyethylene, on the angle between elongation axis and magnetic field direction. This result is discussed on the basis of the formation of an alkyl radical. Data confirm the formation of an alkyl radical on irradiation at 77°K. Polyethylene irradiated at 40 to 50°C gave an epr spectrum with 7 components, each being a doublet. This spectrum corresponds to a uniform interaction of an unpaired electron with 6 protons. This is believed to point to the formation of an allyl radical. Anisotropy was likewise observed in oriented Teflon; the spectra,, however, were not analyzed. No anisotropy was observed with polyvinyl chloride and polyamide. The absence of anisotropy in polymethylmethacrylate and polystyrene is explained by the fact that there is no proton in the immediate vicinity of the unpaired electron, that might cause, as with polyethylene, an anisotropy of hyperfine splitting. (auth)

21223 IRRADIATION OF FABRICS AND LEATHER. Ed. F. Degering, Louis I. Weiner, and Ludwig Seligsberger (Quartermaster Research and Engineering Center, Natick, Mass.). In "Radiation Effects Symposium, No. 4, September 15 and 16, 1959." 13p.

Several fabrics were irradiated by a 2 Mev Van de Graaff electron accelerator at different dose levels and then evaluated with respect to changes in certain mechanical properties. It was observed that the tear strength of fabrics generally decreases with an increase in irradiation. Deterioration is usually detectable at or below 2 Mrep and is relatively rapid. Kuralon, acrilan, and nylon were the most

resistant to irradiation. Various experiments were made on tear strength and weight loss. Chrome-tanned, chrome-retanned, vegetable-tanned upper leather, and untanned hide samples were irradiated at different dose levels, and the effects were evaluated by burst strength, stitch-tearing strength, and shrinkage temperature. It was observed that damage in hide and leather occurs at relatively low levels, and larger doses weaken the fiber structure and lead to increased loss in strength. Several tables and graphs are included. (P.C.H.)

PHYSICS

General and Miscellaneous

21224 (AERE-R-3665) SPENT FUEL ELEMENT ASSEMBLY GAMMA DOSIMETRY AND SAMPLE IRRADIATION. R. W. Clarke, J. B. Price, and F. Rogers (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1961. 29p.

Following chemical dosimetric determination of the gamma fields, an irradiated fuel element assembly was used to irradiate large-scale commercial samples to an accuracy of ±10% of the total dose. Research samples can be irradiated to an accuracy of ±2% of the total dose. (D.L.C.)

21225 (AERE-X/PR-2222) REACTION ON SURFACES AND CRYSTALLINE AMORPHOUS TRANSITIONS. Period covered: October 1956–February 1957. J. Harvey (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1957. 10p.

A description is given of an investigation of the structure and composition of smoke from arcs between electrodes of various metals. The smoke was examined both by high resolution electron diffraction and by electron microscopy. It was found that they fell into two groups: containing crystals with well defined facets, and containing spherical globules with no clear facets. In both cases there was a tendency to form long chains of particles. It is of interest to note that the average particle size quoted from electron microscope data is 500A which is about the diameter of atmospheric condensation nuclei. (auth)

21226 (AFCRL-TN-60-1136) MICROWAVE DETERMINATION OF AFTERGLOW TEMPERATURES AND ELECTRON COLLISION FREQUENCIES IN NITROGEN. Technical Summary Report No. 1. D. Formato and A. Gilardini (Sindel S. p. A., Rome). Apr. 30, 1960. Contract AF61(052)-39. 19p.

Ionization from metastables and shock waves were proposed as explanations for the high electron temperature in the afterglow of d-c nitrogen discharges. Some experiments were performed to sustain or reject these hypotheses. The electron fractional energy loss per collision was also measured and found to be in good agreement with previous measurements by Crompton and Sutton. (auth)

21227 (ARF-1184-1) MAGNETIC PROPERTIES OF INSULATORS. Quarterly Report No. 1, Covering Period February 15, 1961 to May 15, 1961. Jordan J. Markham (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 29, 1961. Contract AT(11-1)-578. 13p.

The magnetic properties of color centers were studied to obtain information regarding electron traps in insulators. Experiments designed to determine the equation governing the recovery of resonance after saturation were carried out. Relatively large samples were prepared by the method of additive coloration. KCl and RbCl crystals were used. Resonance saturation as a function of concentration was investigated and no significant dependence found. Measurements of the unsaturated susceptibility were made at liquid nitrogen and liquid helium temperatures. The bleaching of the F-center to form the B-band produced a different resonance. The equipment for observing the saturation and recovery of a portion of the resonance at 4°K is described. A theoretical examination was made of the interaction between the vibration of the ions around a negative-ion vacancy in an alkali halide and an electron trapped at that site. (M.C.G.)

21228 (CX-51) THE 7s EXCITED STATE OF THE CESIUM ATOM. Harvey J. Brudner (New York Univ., New York. Inst. of Mathematical Sciences). Oct. 1960. Contracts AF19(604)4555; DA-30-069-ORD-2581; and Nonr-285(49). 27p. (AFCRL-TN-60-690; OOR-2360:10).

A technique was developed for the calculation of excited state, one-electron wave functions based on the Thomas-Fermi statistical theory of the atom. The technique is applicable to heavy atoms for which Hartree type solutions are complex and difficult to obtain. The previously obtained Thomas-Fermi core potential for the cesium atom and a Heisenberg type polarization correction were used as a central field in the Schrödinger equation. Correction for penetration of the excited electron's orbital was made, and the Biermann-Lübeck approach for solving the wave equation was utilized. This allowed for the inclusion of a qualitative correction for exchange. The cesium atom's 7s excited state which was not obtained by any Hartree method was computed. (auth)

21229 (NP-10143) RESEARCH ON SEMICONDUCTOR TRANSPORT. Period covered: June 1, 1959–February 1, 1961. K. Hubner (Shockley Transistor Corp., Palo Alto, Calif.). Contract Nonr 2934(00). 54p.

The electrical coupling by phonons of two isolated layers provided a new method which was used to study the propagation properties of phonons in single crystal silicon at a temperature of 77°K. Measurements are given for phonon scattering by holes, dislocations, and oxygen precipitates, with a simple analysis of the results on phonon-phonon scattering. (auth)

21230 (NP-10172) PROJECT SQUID SEMI-ANNUAL PROGRESS REPORT, OCTOBER 1, 1960 TO MARCH 30, 1961. A Cooperative Program of Fundamental Research as Related to Jet Propulsion for the Office of Naval Research, Department of the Navy. (Princeton Univ., N. J. Forrestal Research Center). Apr. 1, 1961. Contract Nonr1858(25). 118p.

Activities in a cooperative program of basic research at 15 laboratory facilities are described for investigations in chemical kinetics, combustion phenomena, fluid mechanics, and transport and transfer processes. (B.O.G.)

21231 (NP-10182) FORMATION OF NEGATIVE IONS IN A GAS BY CHARGE TRANSFER FROM A FAST ATOMIC HYDROGEN BEAM. Technical Report No. 4. T. M. Donahue and Farid Hushfar (Pittsburgh. Univ.). Mar. 1961. Contract DA-36-034-ORD-2912RD. 54p.

Thesis by Farid Hushfar.

A structure is reported in the electron-loss cross section for hydrogen atoms in H_2. Study of the structure in various gases shows that there is no structure for collisions with argon but nine peaks of magnitude $10^{-16}cm^2$ between 8 and 40 Kev in CO. Analysis of the peaks support the idea advanced for hydrogen gas that the peaks are caused by formation of negative ions in the target gas by a process in which the electron is captured as though it were a free electron. Mass spectroscopy studies reveal that negative ions are formed when hydrogen atoms pass through CO, H_2, O_2, and H_2O. The formation rate varies in CO as predicted from the σ_{01} structure and the cross section is

~10^{-16}cm^2. However the type of ions formed does not support the detailed model of the capture process. (auth)

21232 (NP-10186) MEASUREMENT OF THE DISSOCIATION RATES OF HYDROGEN AND DEUTERIUM. Emmett A. Sutton (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). [1960?]. Contract Nonr-401(25). 53p.

Using an interferometer and drum camera to measure the density ratio behind an incident shock wave in mixtures of argon and hydrogen, the dissociation rates for two isotopes of hydrogen were measured. Sufficient data were obtained to measure the rate constants for the reaction at 2800° to 4500°K. The relative efficiencies of argon, the hydrogen molecule, and the hydrogen atom in dissociating hydrogen were found for each isotope. The rate constants for the hydrogen molecule and the argon atom as third bodies for association were found to have a simple 1/T dependence. The rate constants for the collision of three atoms causing association were found to be much larger than the other rate constants and to have a more involved temperature dependence. The rate constant for the association of hydrogen where the third body is a hydrogen atom shows a marked change in its rate-of-decrease at about 3400°K. (auth)

21233 (NP-10264(p.47-59)) PHYSICAL STATE STUDIES. E. C. Freiling (Naval Radiological Defense Lab., San Francisco).

The results of physical state studies of radionuclides in simulated and actual water bursts are summarized and correlated. Particulate, colloidal, and soluble fractions of various fission product radionuclides vaporized under sea water in a carbon arc are given. The activity of the soluble phase after an underwater burst was found to increase from ~35% of the total radioactivity one day or so after explosion to ~60% two weeks later. The percentages of the activity of each radionuclide in ultrafiltrates were determined. Similar data were collected for a shallower water burst and a lagoon burst along with activity vs. particle size correlations for particulate matter. (D.L.C.)

21234 (NP-10274) ACTIVITY AT THE NATIONAL LABORATORIES OF FRASCATI, JULY 1, 1960–DECEMBER 31, 1960. Report No. 9. (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 1961. 47p.

The operation of the electron synchrotron is described. The tasks performed by various groups are briefly described. The experiments being carried out with the electron synchrotron are summarized. The differential cross sections of mesons (π^0) photoproduced in H_2 were measured at 600 to 800 Mev for center-of-mass angles of 57 and 90°; a narrow resonance was detected at ~700 Mev. Some preliminary measurements of the Compton effect of protons with a π^0 background are reported. Fine structure is found in the intensity of the bremsstrahlung produced by 1000-Mev electrons in Si crystals when plotted versus the angles of the electrons and γ rays with respect to the crystalline axis [111]. The angular distribution of the $\gamma + p \rightarrow n + \pi^+$ cross section is given for photon energies between 600 and 700 Mev. Equipment being devised for work on proton polarization and parity conservation in meson (π) photoproduction is described. Measurements on the $\gamma + p \rightarrow \Lambda^0 + K^+$ process at energies of 900 to 1050 Mev are reported. Work performed in various projects on meson (π), (μ), and (K) photoproduction in H_2, D_2, and other nuclei are summarized. (D.L.C.)

21235 (RADC-TR-60-232) A STUDY OF THE STRUCTURE OF SHOCK WAVE FRONTS. Final Report F/148. (Columbia Univ., New York. Electronics Research Labs.). July 31, 1960. Contract AF30(602)-1897. 67p. (AD-247661)

A theoretical discussion is given, followed by a description of the apparatus and measurement techniques employed. Data are presented on the results for shock wave propagation in a three-inch shock tube. Velocities to Mach 6 were attained. Measurements of shock wave velocity decrement and shock front attenuation, employing the gold-film technique and quartz pressure transducers, respectively, show that after a high initial gradient, the attenuation reaches a rate dependent upon the nature of the bounding surfaces and the ambient gas pressure. By adopting an empirical expression for the effect of the boundaries, the attenuation from the gas alone is obtained; this is shown to follow an inverse square-root dependence. (auth)

21236 (UCRL-13001) ON THE SUPERPOSITION OF TWO PLANE WAVES. Jean-Pierre Fortin and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). Apr. 20, 1961. 24p. For California. Univ., Livermore. Lawrence Radiation Lab.

Analyses are presented of the interference of two tensile waves in the case of corner fracture and the interference of reflected waves with the incident wave in spalling. The state of stress caused by one plane wave is analyzed first, then the direction and intensity of the principle stresses from the superposition of two plane waves. Specific examples are given for corner fracture and spalling at various angles of incidence. (B.O.G.)

21237 (WADD-TR-60-853) THE POWER FLOW IN ELECTRON BEAMS AS SEEN BY A MOVING OBSERVER. Rudolf Müller (California. Univ., Berkeley). Aug. 1, 1960. Contract AF33(616)-6139. 26p.

The power flow in an electron beam as seen by a moving observer depends upon the relative velocity between the electrons and the observer. The d-c kinetic power flow goes to zero as the observer approaches the velocity of the electrons. The a-c power flow (the sum of a-c kinetic and electromagnetic power flow) depends upon the relative motion of the observer to the electrons and upon the ratio of the observer's velocity to the phase velocity of the wave propagation. It is shown that the a-c power flow changes sign at points where the observer travels synchronously with the phase of the wave. (auth)

21238 (AD-251872) THE SELF-CONSISTENT FOCK FIELD IN THREE-CONFIGURATION APPROXIMATION FOR THE NEGATIVE LITHIUM ION. T. D. Strotshite and A. P. Yutsis (Iutsis). Translated by Roy Flagg from Trudy Akad. Nauk Litovskoi S.S.R. Ser. B, No. 1, 11-19(1958). 10p.

Solutions of ordinary Fock equations are given for the ground configuration of the negative lithium ion, as well as solutions in two-configuration approximation for radial wave functions 2 p of correction configurations of the two-configuration approximations $1S^22S^2$-$1S^2\,2p^2$ and $1S^22S^2$-$2S^22p^2$. Using the radial wave functions obtained in this way, the value of the total energy in the three-configuration approximation $1S^22S^2$-$1S^22p^2$-$2S^22p^2$ was determined. Results are given for determination of the affinity of the lithium atom. These show that the self-consistent Fock field in one-configuration approximation does not confirm the stability of the negative lithium ion, while the extension of this method to the case of multi-configuration approximation leads to a value of 0.020 atomic units for the electron affinity. (auth)

21239 (AEC-tr-4613) [CRYSTAL PHYSICS]. Waldemar Voigt. Translated from Lehrbuch der Kristallphysik,

p.589-92; 954-60; 962-64. Leipzig-Berlin, Teubner, 1928. 14p.

Information is included on transformation of moduli of elasticity to any system of coordinates, transformation of elastic constants to any coordinate systems, and relations between crystals and quasi-isotropic solids. (auth)

21240 (AEC-tr-4614) II. INDIVIDUAL TYPES OF STRESS. Translated from Handbuch der Physik, 6: 416-22(1928). 8p.

Stress due to uniform pressure on all sides, simple tensile and compressive stress, flexure, and torsion are discussed. Equations for the components of strain due to uniform pressure acting on the surface of a body are given. Calculations of tensile stress are given for a regular system. It is shown that the problems of uniform flexure due to a moment that is constant over the entire length can be solved for all bars of any symmetry class, any orientation of the bar axis, and any cross-section shape. Formulas for torsional stress of crystalline prisms in special orientations are given. (M.C.G.)

21241 (CEA-tr-R-1013) INFLUENCE D'UN CHAMP MAGNÉTIQUE CONTINU SUR LES CARACTERISTIQUES DE L'ALLUMAGE ET DE L'EXTINCTION DE LA DÈCHARGE À HAUTE FREQUENCE. (Effects of a Continuous Magnetic Field on the Ignition and Extinction Characteristics of a High-frequency Discharge). Kh. A. Dzherpetov. Translated into French from Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim., 13: No. 1, 137-46 (1958). 18p.

The effect of a continuous transverse magnetic field on the ignition and extinction potentials of a high-frequency discharge was studied both for the case of a homogeneous and a non-homogeneous electric field. In the former case the discharge was excited between two flat electrodes; in the latter case between coaxial electrodes. The studies were made in H_2 and Ne at 1.2 to 30 Mhz and at different pressures. A fundamental correlation between the ignition and extinction potentials on the one hand and the value of the transverse magnetic field on the other was established. The curve has a minimum at 1,2 Mhz for a higher magnetic field value than for the 30 Mhz curve. Thus, for a given value of field intensity one can to a considerable extent either raise or lower the potentials at these frequencies. As a consequence, using a transverse magnetic field, one can easily control the ignition and extinction of the discharge at these frequencies, this being of great practical value. (T.R.H.)

21242 (NP-tr-625) SECONDARY EMISSION OF NEGATIVE PARTICLES IN THE BOMBARDMENT OF EXTRANEOUS LAYERS ON PURE METALS BY IONS OF ALKALINE ELEMENTS. U. A. Arifov, A. Kh. Ayukhanov, and S. V. Starodubtsev. Translated from Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. Mat. Nauk., No. 2, 107-15(1958). 15p.

A study was made of the secondary emission of negative particles from surfaces in a migration from one pure metal to another pure metal in a process of continuous depositing of one metal on another in bombardment by positive ions of alkali metals. An incandescent tungsten spiral located above a small cup containing alkali halide served as the source of the ions. The targets studied were tungsten, tantalum, molybdenum, and nickel. The purity of a deposited layer was determined by the ratio of the rate of concurrent adsorption of remaining gases from the apparatus contents to the rate of layer depositing. With an increase in the density of a layer there was an increase in the coefficient of secondary negative emission and the energy spectrum of secondary negative particles became softer. The coefficient of secondary negative emission reached a maximum with a certain small layer density and was strongly decreased with a further increase of layer density. It was concluded that secondary ion and electron emission from pure metals in the realm of energy of primary ions to 1 kev has a small value. (M.C.G.)

21243 THE RENORMALIZATION OF TWO-COMPONENT QUANTUM ELECTRODYNAMICS. Herbert Pietschmann (Universität, Vienna). Acta Phys. Austriaca, 14: 63-74(1961). (In German)

The two-component quantum dynamics of the Klein-Gordon type introduced by L. M. Brown and quantized by M. Tonin was explicitly renormalized in the first perturbation theory approximation. The results were compared with meson quantum electrodynamics and with the Dirac theory. It was especially shown that the abnormal magnetic moment is represented as finite (non-divergent) renormalization of the coupling constant. The calculations were then applied to the problem of the electron mass. (tr-auth)

21244 ON THE BREADTHS OF ANNIHILATION LINES IN ONE- AND TWO-VALUED METALS. Bronislaw Sredniawa (Jagellonian Univ., Krakow). Acta Phys. Polon., 20: 235-41(1961). (In English)

The breadths of annihilation lines in the process of annihilation of positrons in metals are analyzed in the case of 16 one- and two-valued metals. For light metals (Li, Be, Na, Mg) positrons are annihilated with conduction electrons only, and for heavier metals the contribution of annihilation with the electrons of the atomic shells increases gradually. For Cu, Ag, and Au the annihilation takes place almost exclusively in atomic shells. (auth)

21245 ON THE EFFECT OF THE AGEING TIME OF THE DEVELOPPER ON NUCLEAR EMULSION BACKGROUND. J. Benisz and W. Chodźba (Higher Teachers Coll., Katowice, Poland). Acta Phys. Polon., 20: 269-71 (1961). (In English)

Nuclear emulsions are developed by the temperature method (amidol developer) and by the method of decreased pH, using developers that are aged up to 5 days. The emulsion background intensity is shown as a function of developer aging time for each of the developing methods. Optimum aging times are recommended for the two methods, and it is noted that the method of decreased pH gives a much smaller background than the temperature method. (T.F.H.)

21246 ON THE STABILITY OF INVISCID PARALLEL FLOW IN HYDROMAGNETICS. R. K. Jain (Univ. of Delhi). Appl. Sci. Research, B, 9: 85-8(1961). (In English)

The stability of parallel flow of conducting and inviscid fluid between two fixed and concentric cylinders in the presence of an axial uniform magnetic field is discussed. It is shown that every flow W(r) is stable for infinitesimal perturbations. (auth)

21247 FIELDS IN SQUARE HELMHOLTZ COILS. R. D. Strattan and F. J. Young (Carnegie Inst. of Tech., Pittsburgh). Appl. Sci. Research, B, 9: 117-24(1961). (In English)

The axial component of the magnetic field in square Helmholtz coils of rectangular cross section is investigated. Expressions for the axial field are derived and simplified enough so that any specific case can be easily calculated with a small internally programmed digital computer. Plots of the field at the center of the coils as a function of winding thickness with coil spacing as a parameter are

presented. Curves of the variation of the field with distance from the center are given. Spherical volumes in which the axial magnetic field varies 1% and 2% are computed for various configurations. The dimensions of the coils which hold the field variations to 1% and 2% over the maximum spherical volume are given. (auth)

21248 COUETTE FLOW OF A FULLY IONIZED GAS, CONSIDERED AS A TWO-COMPONENT FLUID. L. A. Peletier and L. Van Wijngaarden (Technische Hogeschool, Delft, Netherlands). Appl. Sci. Research, B, 9: 141-50 (1961). (In English)

The equations governing the behavior of a fully ionized gas, as given by Spitzer, are applied to two types of magnetohydrodynamic Couette flow. The features of the flow are expressed in terms of the Hartmann number and a parameter q, being the ratio between Larmor frequency and collision frequency. Compared with the results of the one-component theory an additional velocity component is found. (auth)

21249 ON THEOREMS OF MINIMUM ENERGY DISSIPATION IN MAGNETOHYDRODYNAMICS. L. N. Tao (Illinois Inst. of Tech., Chicago). Appl. Sci. Research, B, 9: 161-8(1961). (In English)

Some theorems on the dissipation of energy in magnetohydrodynamics are discussed. It is shown that when certain conditions are satisfied, the steady motion of an electrically conducting incompressible fluid has an absolute minimum of energy dissipation. Furthermore, when the same conditions are satisfied, an unsteady motion with steady boundary conditions always tends to its steady state, which is stable as well as unique. The present theorems are also applicable to ordinary hydrodynamics and magnetohydrostatics. A brief implication of these theorems is discussed. (auth)

21250 ELECTRODE REFRACTION AND ION BEAM COLLIMATION. G. C. Baldwin (General Electric Co., Schenectady, N. Y.). ARS (Am. Rocket Soc.) J., 31: 627-31(May 1961).

Efficient electrode structures for acceleration of ions in electrical propulsion systems are commonly designed so as to establish a potential function at the beam edge identical with that characteristic of space charge limited flow. Since the accelerated beam is intended to generate thrust, it must emerge from an aperture in the accelerator with a high degree of collimation. Consideration must therefore be given also to refraction by the transverse fields unavoidably associated with electrode apertures. In general, an aperture separating a region in which ions undergo acceleration from a region of lower or negative acceleration acts as a divergent lens; if the final stage is decelerating, the exit aperture acts as a convergent lens of greater strength than the aperture preceding it. It can be shown that plane parallel flow in the acceleration region is incompatible with full collimation of the ejected ion beam. The radius of curvature of the beam as it enters the final electrode aperture, the degree of final beam collimation, and the current density that can flow at a given exit voltage are therefore interrelated. This forces a compromise between degree of collimation and perveance, and determines the maximum thrust attainable at a given specific impulse from an emitter of given radius. These considerations apply not only to single stage ion guns but also to multistage (including "accelerate-decelerate") systems. Application of these considerations to the design of a particular accelerate-decelerate electrode configuration is described. (auth)

21251 ELECTRICAL CONDUCTIVITY OF IONIZED AIR IN THERMODYNAMIC EQUILIBRIUM. John R. Viegas and T. C. Peng (Ames Research Center, Moffett Field, Calif.). ARS (Am. Rocket Soc.) J., 31: 654-7(May 1961).

The electric conductivity (σ) of ionized air in thermodynamic equilibrium is calculated for temperatures from 3000 to 24000°K, pressures from 10^{-3} to 10^{2} atm., and densities from 1.293×10^{-9} to 1.293×10^{-2} g/cm^3. The neutral, +1, +2, etc. ionized species are assumed to conduct independently, so that $1/\sigma(\text{total}) = 1/\sigma(\text{neutral}) + 1/\sigma(+1\ \text{ionized}) + \ldots$. Calculations include neutral components N_2, O_2, NO, N, O, and Ar, and charged components N_2^+, NO^+, $O_2^{\pm}$, $O^{\pm,2+,3+}$, $N^{+,2+,3+}$, $Ar^{+,2+}$, and e^-. (T.F.H.)

21252 A WORKING SUBSTANCE FOR MAGNETIC-GAS-DYNAMIC ELECTRIC ENGINES. E. I. Yantovskii. Byull. Izobretenii, No. 11, 31(1960).

A working substance for magnetic-gas-dynamic electric engines, i.e., synchronous rotary-magneto engines with a chamber in the air gap, which the working substance passes through, using an inactive gas containing an admixture of vapor of an alkali metal as the working substance is described. It will achieve maximum electron conductivity. The working substance consists of neon and an admixture of cesium vapor. (auth)

21253 TEMPERATURE AND ELECTRIC CONDUCTIVITY OF ARC WITH SMALL EFFICIENCY. Boleslav Gross (Electrotechnical Inst., Czechoslovak Academy of Sciences, Prague). Ceskoslov. časopis fys., 11: 114-25 (1961). (In Czech.)

Temperature and electric conductivity measurements of the plasma of an arc charged by an alternating current, with attention being paid to the time intervals around zero current are discussed. The results of the measurements are compared with theoretical values calculated according to Mayr's theory. The most important considerations from Mayr's theory are discussed, the procedure in calculating the relative intensity of the lines used for measurement is indicated, and the assumption for their use are discussed. Measurements are performed by spectroscopic methods. The relative intensity emitted by the sodium doublet 3302.32 Å and 3302.99 A is used for measuring the temperature. The time dependence of the temperature of the electrodes is measured to determine the influence of the electrodes on the plasma of the arc. (auth)

21254 THE TRANSITION REGIMES IN CERTAIN FLOWS OF A PERFECTLY CONDUCTING FLUID. Roger Peyret. Compt. rend., 252: 2816-18(May 8, 1961). (In French)

The theory of small perturbations is used to study the transition regimes in the course of which the equations which control the flows of a conducting fluid submitted to a magnetic field parallel to the velocity change type. The simplified equations, the orders of magnitude of the quantity of perturbation, and the similitude parameters are obtained. (tr-auth)

21255 STUDY OF THE REACTIONS PRODUCED BY A BEAM OF MOLECULAR HYDROGEN IONS CROSSING NEUTRAL HYDROGEN AND HELIUM GASES. Joseph Guidini. Compt. rend., 252: 2848-50(May 8, 1961). (In French)

The cross sections of dissociation, dissociation plus ionization, and charge exchange of molecular H_2^+ ions crossing different gases were measured by two methods. The first selects the particles in coincidence. The second selects the particles according to their energy. The agree-

ment between the two methods is verified to almost 2%. (tr-auth)

21256 STABILITY OF A GLOW DISCHARGE IN SMALL CURRENTS. V. Krejčí (Inst. for Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B11: 272-82(1961). (In Russian)

Two approximations of the dynamic characteristic of a glow discharge for small currents are derived. In the first approximation only the influence of the rate of rise and decay of charge carriers in the delay process is accounted for. In the second approximation, the influence of the rate of stabilization of the radial electric field in the discharge is added. On the basis of the derived equations the conditions for the simplest stability of the discharge are calculated. A comparison with experiment gives satisfactory results. (auth)

21257 A NOTE ON THE CROSS-SECTION OF THE LUMINOUS DISCHARGE CHANNEL IN A GLOW DISCHARGE. Kumari D. V. Nagamani and V. T. Chiplonkar (Inst. of Science, Bombay). Indian J. Phys., 35: 128-34(Mar. 1961).

The variations in the cross section (x) and the half width radius (H.W.R.) of a luminous discharge channel are studied for different points in the cathode dark space of a glow discharge in hydrogen and air. Results show that the cross section reaches a minimum value at some distance in front of the cathode; the value of the minimum cross section as well as its location in the cathode dark space is a function of the pressure; both the H.W.R. and x decrease with decreasing pressure in the approximate range 400 to 100 microns. For lower pressures the variation of the two parameters is opposite in character. (auth)

21258 EXPERIMENTAL CONFIRMATION OF LAMB WAVES AT MEGACYCLE FREQUENCIES. D. C. Worlton (General Electric Co., Richland, Wash.). J. Appl. Phys., 32: 967-71(June 1961).

A theory formulated by Lamb, predicting that plates may vibrate in up to an infinite number of modes, is confirmed. The theory is extended to correlate experimental observations. Equations are developed relating phase velocity to frequency and plate thickness in terms of longitudinal and shear wave velocity. Families of curves are obtained for aluminum and zirconium. The distinguishing characteristics of the various modes are discussed in the light of potential nondestructive testing applications. It is shown that the interior particles are displaced in elliptical orbits, with vertical motions existing at the surfaces when the wave velocity is $(2)^{\frac{1}{2}}$ shear wave velocity, and horizontal surface motions existing for wave velocities equal to longitudinal wave velocity. (auth)

21259 EFFECTS OF MONOLAYER ADSORPTION AND BOMBARDMENT DAMAGE ON AUGER ELECTRON EJECTION FROM GERMANIUM. Homer D. Hagstrum (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 1015-19(June 1961).

Data are presented that show how the adsorption of carbon monoxide and oxygen on atomically clean germanium affect the process of Auger neutralization of He^+ and Ne^+ at the surface. Measurements of both total yield and kinetic energy distribution of ejected Auger electrons are made. The effect of ion bombardment alone without subsequent anneal, including the presence of absorbed noble gas in the surface layers of the crystal, is investigated. Photomicrographs of the germanium target surface are reproduced. (auth)

21260 OBSERVATIONS ON THE STRIATION OF ELECTRICALLY EXPLODED COPPER FOILS. Eugene C. Cnare (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys., 32: 1043-4(June 1961).

A high-energy exploding wire facility is used to electrically explode thin metallic foils. Striation patterns are described for which the striation spacing appears to be dependent only on foil thickness and material. Magnetic probe measurements near the foil surface make evident the presence of shear currents in the foil which are believed to be, in part, responsible for the striation phenomena. The explanation of these phenomena may aid in explaining the striated appearance of exploding wires in general. (auth)

21261 ELECTRON BUNCHING IN THE MULTIPACTING MECHANISM OF HIGH-FREQUENCY DISCHARGE. Albert J. Hatch (Argonne National Lab., Ill.). J. Appl. Phys., 32: 1086-92(June 1961).

Electron bunching in the multipacting mechanism of low-pressure high-frequency discharge, also known as the secondary electron resonance mechanism, is analyzed by an extension of simple multipacting theory. The bunching range is assumed to be that range in the electrical phase angle ϕ within which secondary electrons emitted from one electrode can successfully traverse the interelectrode gap in $\frac{1}{2}$ cycle and arrive at the opposite electrode with energy equal to or greater than emission energy. At the lower voltage limit of multipacting, the $\frac{1}{2}$ cycle bunching range is shown to be $-90° \leq \phi \leq +90°$; at the upper voltage limit, the range narrowed to $-90° \leq \phi \leq -40°$. Typical examples of multipacting bunching, including higher-order modes, are illustrated with graphical trajectories. The effects of secondary emission characteristics on bunching are also discussed. (auth)

21262 INITIATION OF A LOW-DENSITY PETN PRESSING BY A PLANE SHOCK WAVE. G. E. Seay and L. B. Seely, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 32: 1092-7(June 1961).

Plane constant-pressure shock waves were used to initiate wedge-shaped pressings of PETN (pentaerythritol tetranitrate). The shocks entered the PETN from brass or Lucite plates. Shock pressures in the plates and depths at which the PETN was initiated were measured with a streak camera. It was found that a 50 kbar shock in the brass was barely sufficient to initiate granular PETN pressed to a density of 1.0 g/cm^3. This corresponded to a derived pressure of about $2\frac{1}{2}$ kbar in the PETN pressing. It was further shown that the interstitial gas had no effect on the depth of initiation. (auth)

21263 MAGNETOHYDRODYNAMIC POWER GENERATION. Syukuro Yano and Tatsumi Hiramoto (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 296-307(Apr. 1961). (In Japanese)

Methods for calculating the electrical conductivity of hot ionized gases in a MHD generator are reviewed and discussed, using the Boltzmann equations for incompletely ionized gases. The present status of theoretical and experimental work in the development of a MHD generator in the U.S.A. is reviewed, with a brief report of researches by the Japan Atomic Energy Research Institute. Prospects and technical problems of MHD power generation using nuclear fuels are discussed. MHD power generation by the future nuclear reactor operating at high temperature is discussed. (auth)

21264 SCATTERING OF HIGH-VELOCITY NEUTRAL PARTICLES. XI. FURTHER STUDY OF THE He-He POTENTIAL. I. Amdur, J. E. Jordan, and S. O. Colgate (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 34: 1525-30(May 1961).

Results are presented for two studies of the scattering by

oom-temperature helium of beams of helium atoms with ontrolled energies in the approximate range 150 to 1500 ev. he interaction potential derived from the two sets of measrements is represented by $\phi(r) = 5.56 \times 10^{-12}/r^{5.03}$ erg, for).97 A < r < 1.48 A). Where there are common ranges of ne interaction distance r this potential is in reasonable greement with He-He potentials determined from scatterng experiments. In its specified range of validity, it is omewhat lower than most of the values calculated quantum nechanically. (auth)

21265 CONDENSATION OF ATOMIC AND MOLECULAR HYDROGEN AT LOW TEMPERATURES. R. T. Brackmann nd Wade L. Fite (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Chem. Phys., 34: 1572-9(May 961).

Using reflected modulated atomic-beam techniques, the eflection of hydrogen atoms and molecules at cold surfaces s examined. It is found that at low temperatures (~4°K) ydrogen atoms reflect as atoms with a very high proba- ility. The reflection of hydrogen molecules is strongly ependent upon the amount of water vapor condensed on he target previously to or simultaneously with the H_2. The act that condensation of stable gases can be affected by imultaneous condensation of water vapor at temperatures xceeding the gases' normal boiling points leads to an ap- lication in the form of an inexpensive way to produce vac- ums in the 10^{-5} mm Hg range. (auth)

21266 SPIN-LATTICE RELAXATION TIME OF F^{19} NUCLEI IN Ag_2F. Q. Won Choi and W. Gilbert Clark Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 34: 1584- .584 (May 1961).

The spin-lattice relaxation time of F^{19} nuclei in Ag_2F rystals is measured at several temperatures. From the nverse proportionality constant of the relaxation time vith respect to temperature in conjunction with the Kor- inga's theory, it is concluded that the relatively large par- magnetic shift observed is not due to the second-order aramagnetism but to the hyperfine interaction between onduction electrons and F^{19} nuclei. (auth)

21267 THE STATE OF THE Nd^{3+} ION AS DERIVED FROM THE ABSORPTION AND FLUORESCENCE SPECTRA OF $NdCl_3$ AND THEIR ZEEMAN EFFECTS. E. H. Carlson nd G. H. Dieke (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 34: 1602-9(May 1961).

The absorption and fluorescence spectra of Nd^{3+} in $NdCl_3$ iluted by $LaCl_3$ are examined with their Zeeman effect at ..2°K and less completely at 77°K. The empirical energy evel diagram is complete up to 28000 cm^{-1} except for the ocation of the ^2K term. Crystal Stark splittings, magnetic roperties, and intensities are compared to calculated alues obtained from an intermediate coupling calculation f the $4f^3$ configuration. (auth)

21268 APPLICABILITY OF APPROXIMATE QUANTUM-MECHANICAL WAVE FUNCTIONS HAVING DISCONTINUITIES IN THEIR FIRST DERIVATIVES. Joseph O. Hirschelder and George V. Nazaroff (Univ. of Wisconsin, Madison). J. Chem. Phys., 34: 1666-70(May 1961).

The method of convolutions is used to form smoothed unctions from approximate wave functions that are dis- ontinuous or have discontinuous first derivatives. As a arameter ϵ in the smoothed function decreases, the moothed function approaches the approximate wave func- ion. The expectation values for physical properties cor- esponding to the approximate wave function are defined to e the limit as ϵ approaches zero of the expectation values orresponding to the smoothed function. It is found that if the approximate wave function is discontinuous, the corresponding expectation value for the kinetic energy is infinite. Therefore, it seems unlikely that discontinuous approximate wave functions can ever be useful. However, if the approximate wave function is continuous but has a discontinuity in its first derivative, then as a result of the discontinuity, there is a contribution $\delta\bar{T}_{12}$ to the expectation value of the kinetic energy. For a one-dimensional problem $\delta\bar{T}_{12} = -(\hbar^2/2m)\ \psi^*(0)\ [\psi_2'(0) - \psi_1'(0)]$. Here $\psi(0)$ is the value of the approximate wave function at the point zero where the discontinuity in its first derivative occurs, and $\psi_1'(0)$ and $\psi_2'(0)$ are the first derivatives of ψ taken from the left and from the right, respectively, at this point. Similarly, for an N-dimensional problem having a surface $S_{12} = 0$ over which the first derivatives of the approximate wave function are discontinuous, $\delta\bar{T}_{12} = \int_{surface} \psi^*[(\partial/\partial n)(\psi_2 - \psi_1)]dS_{12}$. Here the $\partial/\partial n$ is the normal derivative with the normal pointed from region 1 toward region 2. (auth)

21269 REACTIVE SCATTERING IN CROSSED MOLECULAR BEAMS. K ATOMS WITH CH_3I AND C_2H_5I. D. R. Herschbach, G. H. Kwei, and J. A. Norris (Univ. of California, Berkeley). J. Chem. Phys., 34: 1842-3(May 1961).

Beams of K atoms are caused to cross beams of CH_3I or C_2H_5I at an angle of 90°, and the angular distributions of reactively scattered KI are measured. The distributions are explained in terms of beam temperatures, cross sections, and reaction energies. Wand Pt–W detectors are used. (T.F.H.)

21270 STUDY OF A RADIO-FREQUENCY DISCHARGE IN OXYGEN. L. Herman, R. Herman, and D. Rakotoarijimy. J. phys. radium, 22: 1-8(Jan. 1961). (In French)

In a high frequency discharge through flowing oxygen at atmospheric pressure, it was possible, with high dispersion spectrographs, to extend the vibrational and rotational analysis of the Schumann-Runge bands ($B\ ^3\Sigma - X\ ^3\Sigma$ system) up to 5,700 Å. A predissociation at $v' = 3$ and 4 was found; the level $v' = 4$ is strongly predissociated. There seems to be no predissociation at $v' = 5$. In the same discharge, some new atmospheric bands were observed. Each of the $\Delta v = +1$ and $\Delta v = 0$ sequences has five bands. It is suggested that the excitation of the atmospheric bands is due to an interaction between the $X\ ^3\Sigma$ and $b\ ^1\Sigma$ states enhanced at high pressure. (auth)

21271 THE INTERPRETATION OF QUANTUM MECHANICS. III. MATHEMATICAL FORMALISM. A. B. Datzeff (Univ. of Sofia). J. phys. radium, 22: 35-40(Jan. 1961). (In French)

As a summary of the ideas developed in the previous works, the mathematical formalism of the prerelativistic quantum mechanics is given. It is shown that the relations of uncertainty as well as the attempts for their interpretation have always a statistical sense and from them one cannot draw a conclusion for the behavior of a separate particle. (auth)

21272 MODULATION OF THE LUMINESCENCE EXCITED BY α RAYS IN SOME ZINC SULFIDES UNDER THE EFFECT OF ALTERNATING FIELDS. R. Henck and A. Coche (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 59-60(Jan. 1961). (In French)

The luminescent waves which appear on the application of alternating fields (50 Hz) to mixed sulfides of zinc and cadmium (88% ZnS and 12% CdS) activated with manganese in variable proportions and excited by α particles from a Po^{210} source were studied. The phenomena in the blue and orange emission bands were observed. The luminescent waves show two maxima per field period. The modulation

percentage was determined as a function of the voltage in the two emission bands. The modulation first increases with voltage, passes through a maximum, and then approaches a limit. (J.S.R.)

21273 VARIATION OF THE ENHANCEMENT EFFECT OF THE LUMINESCENCE EXCITED BY α RAYS WITH THE LENGTH OF THE EMISSION WAVE AND THE FREQUENCY OF THE ELECTRIC FIELDS. R. Henck and A. Coche (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: 98-100(Feb. 1961). (In French)

The enhancement effect of electric fields on α excited phosphors of the type ZnS:CdS activated with Mn, was studied as a function of the emission wavelength of the phosphor and of the frequency (0.005 c/s to 50 kc/s) of the applied electric fields, for several concentrations of manganese. (auth)

21274 THE INTERPRETATION OF QUANTUM MECHANICS. IV. OBSERVATION AND REALITY. A. B. Datzeff (Univ. of Sofia). J. phys. radium, 22: 101-12(Feb. 1961). (In French)

The following objective sense was ascribed to the relations of uncertainty, with which observation is not a decisive factor. The values of each physical quantity in the field of the microworld are subjected to chaotic changes in the course of time. The dispersions of each couple of canonically conjugated quantities are not independent, but there exists a dependence between them expressed by the corresponding relation of uncertainty. (auth)

21275 THE CHARACTERISTICS OF THE DISCHARGES IN THE CROSSED ELECTRIC AND MAGNETIC FIELD. Shigeru Hawakawa (Matsushita Electrical Ind. Co., Ltd., Osaka) and Tokuo Suita. J. Phys. Soc. Japan, 16: 1037-8 (May 1961).

Experimental results on gas discharge in crossed electric and magnetic fields are discussed. The current-voltage characteristic for a particular discharge is graphically shown. Also shown graphically is how the applied voltage is related to the delay time under constant magnetic field strength and vacuum pressure, double probe signal and discharge current of the detected output, and the time variation of the space potential between electrodes after voltage is introduced. From these results it is assumed that the space charge is accumulated between electrodes during the pre-discharging period, initiating the discharge. Therefore the delay time is related to the ion density due to collisions between molecules and electrons under the sudden application of the electric field. This indicates that the delay time decreases considerably with respect to the increase in the ionization efficiency of electrons as the applied voltage is raised. (N.W.R.)

21276 MEAN MOTIONS IN CONDITIONALLY PERIODIC SEPARABLE SYSTEMS. John P. Vinti. J. Research Natl. Bur. Standards, 65B: 131-5(Apr.-June 1961).

A theorem is presented, which states that in any conditionally periodic separable system the mean frequency n_k of any separation coordinate q_k is equal to $\partial\alpha_1/\partial J_k$. Here α_1 is the energy and J_k is the k'th action variable. The proof is carried out for nonsingular Staeckel systems, so that it is applicable to any nonpolar orbit of an artificial satellite, when the potential leads to separability. (auth)

21277 PULSED NEUTRON SOURCES. P. R. Barrett, R. S. Hall, D. Jakeman, S. A. Scott, and J. Walker (Univ. of Birmingham, Eng.). Nuclear Eng., 6: 230-2(June 1961).

Fairly monoenergetic neutrons may be produced by reactions of deuteron beams on deuterium or tritium at ~200 kev, yielding neutron energies of 2.5 or 14 Mev, respectively. Uses of these neutron beams, pulsed or continuous, are described in studies of neutron diffusion in water, diffusion cooling, and slowing down. The application of pulsed sources to subcritical assembly exponential experiments is examined. (T.F.H.)

21278 A SOURCE FOR THE PRODUCTION OF LARGE DC ION CURRENTS. G. G. Kelley, N. H. Lazar, and O. B. Morgan (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods, 10: 263-71(Apr. 1961). (In English)

A source for the production of large ion currents was developed based on the "duo-plasmatron" principle. Constant hydrogen ion currents in excess of 300 ma were obtained with accelerating voltages up to 80 kv. The mass ratios of hydrogen ions were analyzed magnetically with currents up to 100 ma. In this range, up to 70 per cent of the total current was H_2^+. The operating characteristics of the source were determined as the various parameters were independently varied. (auth)

21279 FADING IN NUCLEAR EMULSIONS INDUCED BY ACID AGENTS. Hans Ackermann and Helmut Faissner (Universität, Tübingen, Ger.). Nuclear Instr. & Methods, 10: 339-42(Apr. 1961). (In English)

β and γ ray induced background in nuclear emulsions of moderate and low sensitivity was removed after the irradiation by treating with acid agents. The dependence of this background eradication on the pH of the solution, the duration of treatment, and other parameters was studied in some detail. The eradication was uniform in depth and easily adjustable. For instance, it was possible to suppress β and γ induced fog without destroying α-tracks. A stronger treatment removed the latent images of α tracks too. The treatment caused no irreversible changes: after the removal of the acid medium the emulsions had their original sensitivity again. Under certain precautions, the acid could be brought into the emulsion before irradiation. This had the effect of an apparent desensitization. It was ascertained, however, that also in this case the formation of the latent image was not impeded. Rather the active centers were removed within a few minutes after irradiation. (auth)

21280 DETECTION EFFICIENCY OF A PLASTIC SCINTILLATOR FOR NEUTRONS IN THE ENERGY RANGE OF 1 TO 14 MeV. H. Grässler and K. Tesch (Technische Hochschule, Aachen). Nuclear Instr. & Methods, 10: 353-5(Apr. 1961). (In English)

The detection efficiency of a plastic scintillator for neutrons in the energy range 1 to 14 Mev is measured by scattering 14.1 Mev neutrons on polyethylene. The results are compared with theoretical calculations. (auth)

21281 ON THE NATURE OF THE ELECTROMAGNETIC FIELD. Tetsuo Gotō (Nihon Univ., Tokyo). Nuclear Phys., 24: 388-99(1961). (In English)

In an attempt to identify the electromagnetic fields as an affine connection for spinors, the natures of the electromagnetic interaction and the electric charge are investigated. All spinors interact with the electromagnetic field. The possibility of charge independence is studied. The violation of the charge independence by the electromagnetic field is apparently caused by the violation of the flatness of space-time. (auth)

21282 THE ELECTRICAL RESISTIVITY OF ZrZn. C. E. Olsen (Los Alamos Scientific Lab., N. Mex.). Phys. and Chem. Solids, 19: 228-9(May 1961). (In English)

Electrical resistivity measurements on the ferromagnetic intermetallic compound $ZrZn_2$ between 2.2 and 295°K fail to show an anomaly at the ferromagnetic transition

uch as are observed in other ferromagnetic elements and ompounds. A possible mechanism is considered for this ehavior. (auth)

1283 THE EFFECT OF PRESSURE AND TEMPERATURE ON THE ABSORPTION EDGES OF THREE SILVER ALIDES. A. S. Balchan and H. G. Drickamer (Univ. of llinois, Urbana). Phys. and Chem. Solids, 19: 261-4(May 961). (In English)

The effect of pressure to 160 kilobars, combined with mperature to 400°C is measured on the absorption edge f AgCl, AgBr, and AgI. The behavior of AgCl and of AgBr s nearly identical. In the low pressure (fcc) phase there s a red shift with pressure at low temperature. At high mperature the edge shifts blue with increasing pressure. possible explanation in terms of the defect structure is roposed. The high pressure phase shows a normal red hift with pressure at all temperatures. The behavior of gI in the fcc phase is anomalous both at room tempera- ure and at elevated temperature. (auth)

1284 DIFFUSION OF THALLOUS IONS IN POTASIUM BROMIDE, MEASURED BY THE SPECTROPHOTOMETRIC METHOD. A. Glasner, A. Rejoan, and . Reisfeld (Hebrew Univ., Jerusalem). Phys. and Chem. olids, 19: 331-7(May 1961). (In English)

The diffusion of thallous ions in potassium bromide, in ne impurity range of temperatures, was measured by the pectrophotometric method. The energy of activation Q was ound to be 23,500 cal/mole. The pre-exponential factor D_0 aried with the experimental conditions, the effect being ttributed to variations in the "face boundary," as indiated by experiments carried out under a reduced atmosheric pressure. From experiments with pressed pellets t was deduced that the original equation used in calculating he diffusion constants D needed correcting as follows:) = $(E_t/E_\infty)^{2/2}/(10.3)^2 t$. This gives for the diffusion of thalous ions in potassium bromide: $D_{Tl^+} = 0.23 \exp(-23{,}500/RT)\,cm^2/sec$. Previous values of D and D_0 reported for the iffusion of thallous and lead ions in potassium chloride hould similarly be divided by a factor of three. (auth)

1285 LINKED-DIAGRAM EXPANSION FOR THE QUATION OF STATE OF A GAS OF MOLECULES. Allan N. Kaufman and Kenneth M. Watson (Univ. of California, Berkeley and Livermore). Phys. Fluids, 4: 55-62(June 1961).

The method of the linked-diagram expansion is applied o the equilibrium statistical mechanics of a nondegenerate as of molecules, taking into account the structure of the molecules, and using the Pauli principle for all the elecrons. The equation of state is obtained in the form of a irial expansion. (auth)

1286 VISCOSITY OF TWO-COMPONENT GASEOUS MIXTURES. Joseph O. Hirschfelder, Marion H. Taylor, Taro Kihara, and Reginald Rutherford (Univ. of Wisconsin, Madison). Phys. Fluids, 4: 663-8(June 1961).

The conditions are found for which the viscosity of a inary mixture of dilute gases either has a maximum or inimum with respect to variations in the composition. A maximum in the viscosity is most likely to occur for a nixture of a polar and nonpolar gas in which the viscosiies of the pure components are nearly equal and their nolecular weights are quite different. A minimum should ccur for a mixture of two nonpolar gases in which both he viscosities and molecular weights of the pure comonents are nearly equal. There are 17 experimental exmples of maxima (and three additional mixtures with redicted maxima) in the viscosity, but up to the present time no cases are discovered in which the viscosity has a minimum. A comparison between theory and experiment shows agreement for the viscosity of binary mixtures. (auth)

21287 THEORY OF THE MOLECULAR FRICTION CONSTANT. Eugene Helfand (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Fluids, 4: 681-91(June 1961).

The molecular friction tensor, as given by a time integral of an autocorrelation of forces, is calculated with the assumption that the trajectories of the particles are linear and unaccelerated for the times of interest. Such trajectories are appropriate to lowest order in the force on a particle. An application is made to particles interacting via a Coulomb potential. The result derived by Chandrasekhar is obtained, without the introduction of a cutoff for large distances. In order to handle molecular systems, the "soft" part of the potential is treated by the linear trajectory technique, and a small term is added to account for hard-core collisions. (auth)

21288 THEORY OF ELECTRON DRIVEN SHOCK WAVES. R. G. Fowler and B. D. Fried (Space Tech. Labs., Inc., Los Angeles). Phys. Fluids, 4: 767-70(June 1961).

Calculations of the time required for ion heating in the discharge or driver section of an electrical shock tube yield values much greater than that in which formation and acceleration of the first luminous front is observed to occur. An electron-driven-shock model is presented, which shows that the relation between shock velocity V and electron temperature T_e, which is established experimentally over a wide range of parameters, remains valid even though the conventional picture of a shock driven by hot ions must be abandoned. Thermal expansion of the hot electron gas accelerates the cold ions of total mass = M, resulting in a shock front or moving electrostatic double layer. Assuming conditions behind the shock to be coupled to those in the discharge region through a simple rarefaction wave, it is found that MV^2/kT_e is a universal function of W/MV^2, where W is the effective ionization potential. This is shown to agree with a wide variety of experimental data. (auth)

21289 MOTION OF A CHARGED PARTICLE IN AN AXIALLY SYMMETRIC MAGNETOSTATIC FIELD. E. Mishkin and C. Rader (Polytechnic Inst., Brooklyn). Phys. Fluids, 4: 783(June 1961).

The motion of a charged particle in an axially symmetrical magnetostatic field is studied. It is assumed that the variation of the field over a Larmor radius is small compared to the value of the field. The motion of the particle consists of cyclotron rotation about a guiding center. The Lagrangian of the field is used to find the motion of this guiding center, by an averaging process over all values of the Larmor radius. (T.F.H.)

21290 INFLUENCE OF A STATIC ELECTRIC FIELD ON POSITRONIUM FORMATION IN POLYMERS. A. Bisi, F. Bisi, A. Fasana, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Phys. Rev., 122: 1709-10(June 15, 1961).

The effect of a static electric field on positronium formation in some polymeric materials is detected by a study of the time delay spectrum of the annihilation γ rays. Typical nonpolar polymers, like polyethylene and Teflon, show a strong decrease in positronium formation with increasing electric field, (33% and 13%, respectively, at 50 kv/cm), while no effect is found in polar polymers, like Lucite, nylon and polyvinyl chloride. (auth)

21291 MAGNETIC COUPLING IN Pd-DILUTE IRON GROUP ALLOYS. E. O. Wollan (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 1710-13(June 15, 1961).

The magnetic properties of palladium and its alloys with iron group elements are discussed in terms of the splitting of the d orbitals. The paramagnetic properties of pure palladium are accounted for on the basis that the holes in the d shell are associated with the nonoverlapping e orbitals, whereas the ferromagnetic coupling in the face-centered 3d elements and their alloys is associated primarily with holes in the overlapping t orbitals. On this basis and on the basis of a change in the splitting when palladium is alloyed with 3d metals, it is possible to account for the paramagnetic and ferromagnetic properties of the Pd-dilute iron group alloys. Because of the larger amount of available data, attention is given primarily to the Pd-Fe system. (auth)

21292 INTERNAL MAGNETIC FIELDS IN MANGANESE-TIN ALLOYS. Luise Meyer-Schützmeister, R. S. Preston, and S. S. Hanna (Argonne National Lab., Ill.). Phys. Rev., 122: 1717-20(June 15, 1961).

The hyperfine fields at the tin sites in two manganese-tin alloys are studied as a function of temperature to above the Curie points. In addition to the Zeeman splittings, a possible quadrupole interaction of about 27 Mc is observed in Mn_2Sn. In Mn_4Sn the hyperfine field is small and negative, about −45 kgauss; in Mn_3Sn it is large and positive, about +200 kgauss. As in the case of the pure ferromagnetic transition elements, it seems necessary to invoke a positive term associated with conduction-electron polarization and a negative one arising from core polarization to explain these results. (auth)

21293 LOW-TEMPERATURE OPTICAL BLEACHING OF F CENTERS IN KCl. A. R. Reinberg and L. I. Grossweiner (Illinois Inst. of Tech., Chicago). Phys. Rev., 122: 1734-41(June 15, 1961).

Optical bleaching of F centers in x-rayed and additively colored KCl is studied at 77°K with pulse irradiation methods. Constant "F light" incident on the colored crystal establishes a photostationary equilibrium between F and F′ centers. The application of a high-intensity light flash of appropriate spectrum displaces the system from equilibrium to either direction. The return to equilibrium is exponential in time, with a rate controlled by the intensity and spectrum of the constant light, but not depending on the F-center concentration or the method of coloration. The results are in agreement with a kinetic model involving only F-to-F′ center interconversions. Prior room-temperature optical bleaching inhibits the extent and rate of low-temperature bleaching, probably due to the growth of other bands under the F band. The saturation of the extent of bleaching at high pulse-light intensity and a lower bleaching efficiency for the additively colored crystal indicate that the distribution of F centers in the crystal is significant in low-temperature bleaching. (auth)

21294 ELECTRON-ELECTRON SCATTERING AND TRANSPORT PHENOMENA IN NONPOLAR SEMICONDUCTORS. Joachim Appel (General Atomic Div., General Dynamics Corp., San Diego). Phys. Rev., 122: 1760-72 (June 15, 1961).

The effects of electron-electron scattering processes caused by Coulomb forces on the transport phenomena in nonpolar isotropic solids are treated in the framework of Kohler's variation principle. By considering the conduction electrons as a Fermi-Dirac gas of noninteracting free quasi-particles, electron-electron scattering is taken into account as a small perturbation, in the same manner as is electron-phonon scattering in nonpolar solids. A shielded Coulomb potential that depends on two parameters—the effective dielectric constant and the shielding constant—is used as the interaction potential. These two parameters, for small concentrations of electrons, may be assumed to be independent of the distance between two electrons during a scattering process. A general qualitative result is that electron-electron scattering causes the electrical conductivity to be reduced less than the electronic heat conductivity. The conductivities and the Wiedemann-Franz ratio are reduced by an amount determined by the energy dependence of that perturbation of the electron distribution which is induced by primary scattering sources such as electron-phonon scattering or electron-impurity scattering. Quantitative results for nondegenerate semiconductors are obtained in terms of the variational method. With electron-phonon and electron-ion scattering assumed in turn as the primary scattering mechanism, the effects of electron-electron scattering on the electrical conductivity, the heat conductivity, and the Seebeck coefficient are calculated as functions of temperature. The effect of electron-electron scattering on transport phenomena in metals is considered. The applicability of the results obtained for isotropic semiconductors to an important class of anisotropic semiconductors is shown. (auth)

21295 EFFECT OF INTERACTIONS ON DETERMINATION OF FERMI SURFACES. Edward A. Stern (Univ. of Maryland, College Park). Phys. Rev., 122: 1773-80 (June 15, 1961).

The effects of both electron-electron and electron-phonon interactions on a degenerate electron gas in a uniform positive background are considered. It is shown that when electron-electron interactions alone are considered, the free-electron mass may be measured by cyclotron resonance, the Faraday effect, and optical constants. However, the period of the de Haas-van Alphen oscillations is changed from the value calculated neglecting interactions, and is changed in the same way that the specific heat is. When electron-phonon interactions are added, however, the situation changes. In particular, it is shown that the cyclotron mass is no longer the free value, and the de Haas-van Alphen period and the specific heat are changed in different ways. Comparison with measurements on aluminum, which approximates the model used, shows that both electron-phonon and electron-electron effects are important and of the same magnitude. (auth)

21296 NEW PROCESS OF EXCITATION TRANSFER IN HELIUM. Robert M. St. John and Richard G. Fowler. (Univ. of Oklahoma, Norman). Phys. Rev., 122: 1813-20 (June 15, 1961).

Precise observations are made on light emission from low triplet levels of helium gas traversed by a monoenergetic electron beam, with varying helium pressure and electron energy. This triplet excitation was previously ascribed to direct transfer from ^1P states, in violation of the Wigner rule, and seemingly excessive cross sections for the transfer were inferred. A process of excitation transfer is proposed that minimizes the conflict with the Wigner rule by reducing the sizes of the cross sections required to values close to the gas-kinetic cross section. It is hypothesized that many ^1P states, including those with large quantum number n, transfer excitation energy to neighboring triplet states having closely corresponding principal quantum numbers. The triplet states thus formed populate low-level triplet states by radiative transitions. It is found that states lying between n = 4 and n = 15 play

ie dominate role in the transfer process. Qualitative ex-lanations of several additional excitation-transfer-process henomena are derived from this multiple-state-transfer rocess. (auth)

1297 CANCELLATION OF KINETIC AND POTENTIAL NERGY IN ATOMS, MOLECULES, AND SOLIDS. Morrel . Cohen (Univ. of Chicago and Hughes Research Labs., alibu, Calif.), and V. Heine. Phys. Rev., 122: 1821-6 une 15, 1961).

In the energy levels of valence electrons in atoms, mole-ules, solids, and liquids, there is a contribution from the rge negative potential energy inside the core of the atom d the large positive kinetic energy which the electron as there. The kinetic energy can be represented by a epulsive pseudopotential that cancels most of the potential nergy inside the core. The explicit representation of the seudopotential is now developed further to demonstrate ore clearly the extent of the cancellation. The formalism stifies the simple models for valence electrons. It is so used to relate similar atoms from different rows of e periodic table, and in particular to discuss the system-ic trends in the energy levels of the alkali and noble metal toms. (auth)

1298 CONFIGURATION INTERACTION IN SIMPLE TOMIC SYSTEMS. A. W. Weiss (Univ. of Chicago). hys. Rev., 122: 1826-36(June 15, 1961).

The ground state wave functions of helium, lithium, and eryllium are approximated by a superposition of con-gurations with expansion lengths ranging from 35 for elium to 55 for beryllium. The discrepancis in the total nergy are 0.014 ev for helium, 0.026 ev for lithium, and 17 ev for beryllium. A 19-configuration function is also plied to the lowest ^3S state of helium, with a resulting ccuracy of 0.0005 ev. The calculations are also made on l the isoelectronic series of ions through Z = 8, the dis-repancy remaining of the same order of magnitude but ncreasing with increasing Z. A lower bound to the electron ffinity of lithium is set at 0.4773 ev, with the most prob-ble value, obtained by extrapolating the isoelectronic eries, being placed at 0.62 ev. (auth)

1299 PERTURBATIVE TREATMENT OF PAIRING ORCES IN MANY-FERMION SYSTEMS. M. Bolsterli niv. of Minnesota, Minneapolis). Phys. Rev., 122: 1946-June 15, 1961).

A noncanonical transformation that allows perturbative chniques to be applied to the pairing force problem is troduced. The lowest-order eigenvalue equation gives e standard results for both strong and weak coupling. uth)

1300 QUADRUPOLE MOMENT OF Li^7 AND QUAD-UPOLE COUPLING CONSTANT OF Li_2. S. L. Kahalas nd R. K. Nesbet (Boston Univ., Mass.). Phys. Rev. Let-ers, 6: 549-50(May 15, 1961).

The quadrupole moment (Q) of Li^7 in LiH is calculated rom the quadrupole coupling constant (q) and the electric eld gradient at the Li^7 nucleus. Using this value of Q, the uadrupole coupling constant of Li_2 is calculated. The cal-ulations yield $Q = +3.56 \cdot 10^{-26}$ cm^2, and $q = -0.049$ Mc. I.F.H.)

1301 ON THE QUANTUM STATISTICAL BASIS OF ON-EQUILIBRIUM THERMODYNAMICS. [PART] I. . Vlieger, P. Mazur, and S. R. de Groot (Universiteit, eiden). Physica, 27: 353-72(Apr. 1961). (In English)

The quantum statistical theory of Wigner distribution unctions is developed to serve as a basis for the deriva-ion of the Onsager reciprocal relations in non-equilibrium thermodynamics. The theory is closely analogous to the classical treatment, given by de Groot and Mazur. The following topics are discussed: (1) Time dependence of Wigner distribution functions, described by means of a propagator. The properties of this propagator are studied. (2) Equilibrium distribution function of a set of extensive state variables, which provide a macroscopic description of the system, assuming that these variables are represented by commuting operators in quantum theory. This probability distribution function is expressed in terms of the Wigner distribution function of the microcanonical ensemble, representing thermodynamic equilibrium. The properties of distribution functions of extensive variables, in particular those with regard to the even or odd character of these variables, are studied. (3) Definition of a set of intensive thermodynamic variables, conjugate to the extensive state variables, by means of Boltzmann's entropy postulate. The theory is developed only for Maxwell-Boltzmann statistics. (auth)

21302 LOW QUANTUM TRANSITIONS IN WATER AND ICE. H. R. Danner and H. H. Stiller (C.E.N., Mol, Belg. and Kernforschungsanlage, Jülich, Ger.). Physica, 27: 373-5(Apr. 1961). (In English)

Neutron spectroscopy reveals the existence of low quantum transitions in ice. The results are graphically shown for a scattering angle $\phi = 60°$ for incident energies between 4 and 6.2 Mev. Three distinct increases of $N(E_0)$ are observed. The amount of increase is found to be $\Delta_1 N(E_0) \simeq \Delta_2 N(E_0)\ (1 + \alpha)$, where $\Delta_2 N(E_0)$ is the amount of increase at 4.73 Mev and α is the ratio of Be filter transmission increases at 6.32 and 5.20 Mev, respectively. (N.W.R.)

21303 THERMODYNAMIC PROPERTIES OF AN ISOTOPIC MIXED CRYSTAL. Jean Pirenne (Université, Liège). Physica, 27: 385-402(Apr. 1961). (In English)

An expression of the frequency distribution of the crystal formed by a single element possessing several isotopes, whose atoms are assumed to be distributed at random throughout the lattice points, is derived. It is applied to the computation of the thermodynamic properties changes resulting from the isotope mixing. (auth)

21304 LIQUID HYDROGEN AND DEUTERIUM TARGETS. M. Bougon, M. Marquet, and P. Prugne (C. E. N., Saclay, France). Proc. Congr. Refrigeration, 10th Congr., Copenhagen, 1959, 1: 207-10. (In French)

An atmospheric pressure and vacuum target is described. The atmospheric pressure target of liquid hydrogen is 400 mm long and thermal insulated with styrofoam. The hydrogen vapors are used to improve the target cooling. Mylar windows are used. The vacuum target of hydrogen or deuterium of 12 liter content is 400 mm thickness and is thermal insulated by a vacuum vessel and a liquid nitrogen shield. Recovery and liquefaction of deuterium vapors are managed in the vacuum vessel which holds the target. The target emptying system is designed for operating in a few minutes. (N.W.R.)

21305 THE LAW OF WIEDEMANN AND FRANZ. G. V. Chester (Univ. of Birmingham, Eng.) and A. Thellung. Proc. Phys. Soc. (London), 77: 1005-13(May 1, 1961).

The exact expressions for the transport coefficients of a metal are used to show that the Wiedemann–Franz law is valid, provided that the electrons do not interact with each other and form a degenerate Fermi–Dirac assembly, and that the scattering of the electrons is due to impurities or lattice vibrations and is elastic. The derivation is valid no matter how strong the scattering and it is therefore more

general than the usual weak-coupling derivation of the Wiedemann–Franz law. (auth)

21306 AN X-RAY ABSORPTION PROCESS IN IONIC CRYSTALS. P. E. Best and J. L. Robins (Univ. of Western Australia, Nedlands). Proc. Phys. Soc. (London), 77: 1046-9(May 1, 1961).

Peaks at 9.8 ev and 13.9 ev in the observed characteristic electron energy loss spectrum of potassium chloride are identified as being due to the excitation of surface and volume plasma oscillations respectively. The first two maxima of the K x ray absorption spectrum of the chloride ion in potassium chloride are of energy 9.8 ev and 13.6 ev greater than the valence → K emission line, and it is proposed that these two peaks are caused by the transition K → valence plus excitation of some mode of plasma oscillation. It is suggested that corresponding peaks in the x ray absorption spectra of other ionic crystals have the same origin. (auth)

21307 THE ELECTRONIC ENERGY BANDS OF THE ALKALI METALS AND METALLIC BERYLLIUM. J. F. Cornwell (Imperial Coll., London). Proc. Roy. Soc. (London), A, 261: 551-64(May 23, 1961).

The applicability of various electronic energy band interpolation schemes to the alkali metals and metallic beryllium is discussed. An 'l-dependent' pseudo-potential method using only a very small number of plane waves in the expansion of the valence electron wave functions is applied to these metals. The density-of-states curves and the Fermi surfaces are calculated. It is found that for lithium the Fermi surface may touch the Brillouin zone boundaries. The calculated and observed low temperature electronic specific heat coefficients and valence band widths are compared. (auth)

21308 AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES. M. Cohen and A. Dalgarno (Queen's Univ., Belfast). Proc. Roy. Soc. (London), A, 261: 565-76(May 23, 1961).

An expansion method is described that provides a simple and rapid means of calculating for any atom the expectation values of sums of one-electron operators. All the equations that arise can be solved analytically and the results are obtained as functions of the nuclear charge. For inner shells the accuracy is comparable with that of the Hartree–Fock approximation. The method gives a quantitative description of the effects of direct and exchange interactions between electron shells. Results are given for all members of the helium and beryllium iso-electronic sequences. (auth)

21309 SPIN-CHANGE CROSS-SECTIONS. A. Dalgarno (Queen's Univ., Belfast). Proc. Roy. Soc. (London), A262: 132-5(June 13, 1961).

A quantal formulation of spin-change processes in collisions of atomic systems is presented. The cross section for the spin-change process in the collision of two hydrogen atoms is computed for temperatures up to 10,000°K and the results given. (auth)

21310 THE USE OF ELECTRON GAS MODIFICATION IN THE EVALUATION OF THE VIBRATION FREQUENCIES AND THE SPECIFIC HEATS OF SODIUM AND POTASSIUM. B. Dayal and B. Sharan (Banaras Hindu Univ., India). Proc. Roy. Soc. (London), A262: 136-44(June 13, 1961).

Earlier work on the determination of the specific heats of lithium by the use of deLaunay's model is extended to sodium and potassium. A new technique is introduced in which the contributions of the central and the outer parts of the Brillouin zone to C_v are calculated separately from different distribution densities of 8000 and 1000 points per zone, respectively. The agreement between the calculated and the experimental values of C_v is found to be very good except at very low temperatures where the deviations can be ascribed to the presence of phase transformation. The effect of using a finer mesh of points on C_v is examined. In order to get accurate values of C_v the density of points in the central region has to be increased considerably. In the outer region, however, a low density of eight points per zone as in Raman's theory is found to be reasonably satisfactory. (auth)

21311 SCIENTIFIC APPLICATIONS OF NUCLEAR EXPLOSIONS. George A. Cowan (Los Alamos Scientific Lab., N. Mex.). Science, 133: 1739-44(June 2, 1961).

Proposals are reviewed for the application of nuclear explosions in basic scientific research. Nuclear explosions are of interest as intense sources of neutrons, neutrinos, plasmas, high temperatures, gamma rays, x rays, light, shock, and radioactive isotopes. Experiments which use one or more of these properties are reviewed. (C.H.)

21312 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY, 1961 ANNUAL MEETING, PITTSBURGH, PENNSYLVANIA, JUNE 4-8, 1961. Joseph H. Bach, ed. Trans. Am. Nuclear Soc., 4: No. 1, 177p.(June 1961). (Suppl. to Nuclear Sci. and Eng.). $5.00.

The 201 papers summarized in this issue of the TRANSACTIONS are included in Nuclear Science Abstracts by title only under the appropriate subject categories. However, they have been indexed fully in the personal author and subject indexes. (L.T.W.)

21313 A THICK PARTIALLY-PLASTIC TUBE WITH FREE ENDS AND INTERNAL HEAT GENERATION. W. A. Beyer (Los Alamos Scientific Lab., N. Mex.). Trans. Am. Nuclear Soc., 4: No. 1, 13(June 1961).

21314 PRODUCTION OF HIGH-INTENSITY PURE THERMAL NEUTRON CURRENTS BY DIFFUSION TIME DISCRIMINATION. F. S. Holzer (AMF Atomics, Greenwich, Conn.). Trans. Am. Nuclear Soc., 4: No. 1, 37(June 1961).

21315 NEUTRON SELF-SHIELDING IN COBALT WIRES AND FOILS. T. A. Eastwood and R. D. Werner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans Am. Nuclear Soc., 4: No. 1, 61-2(June 1961).

21316 FOIL ACTIVATION DATA HANDLING WITH AUTOMATIC COUNTERS AND A HIGH SPEED COMPUTER. K. E. Plumlee and M. T. Wiggins (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 62-3 (June 1961).

21317 ELECTRON ACCELERATOR PHOTONEUTRON SOURCE. W. E. Mott, D. F. Rhodes, and R. A. Stallwood (Gulf Oil Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 125-6(June 1961).

21318 AN OPTICAL ANALOG FOR NEUTRON RADIOGRAPHY. H. V. Watts and C. A. Stone (Armour Researc Foundation, Chicago). Trans. Am. Nuclear Soc., 4: No. 1 127-8(June 1961).

21319 SPACEPROBE RADIOISOTOPE THERMOELEC TRIC GENERATOR POWER SYSTEM DESIGN CONSIDERA TIONS. H. H. Greenfield and R. E. Kittleson (Lockheed Aircraft Corp., Sunnyvale, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 161-2(June 1961).

21320 SELECTION OF POWER REQUIREMENTS FO NUCLEAR ELECTRIC SPACECRAFT MISSIONS. J. P. Davis (Jet Propulsion Lab., Pasadena, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 162(June 1961).

21321 THE CONCEPTUAL DESIGN OF A NUCLEAR ELECTRIC POWERED SPACECRAFT FOR THE EXPLORATION OF JUPITER. R. J. Beale (Jet Propulsion Lab., Pasadena, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 162-3(June 1961).

21322 NUCLEAR POWERED LUNAR ROCKETS. R. S. Cooper (Los Alamos Scientific Lab., N. Mex.). Trans. Am. Nuclear Soc., 4: No. 1, 163-4(June 1961).

21323 GAMMA RAY DOSAGES AT THE PAYLOADS OF NUCLEAR ROCKETS. J. R. Streetman and G. A. Graves (Los Alamos Scientific Lab., N. Mex.). Trans. Am. Nuclear Soc., 4: No. 1, 164-5(June 1961).

21324 RADIATION HEATING IN THE LIQUID HYDROGEN PROPELLANT OF NUCLEAR ROCKETS. G. A. Graves and J. R. Streetman (Los Alamos Scientific Lab., N. Mex.). Trans. Am. Nuclear Soc., 4: No. 1, 165(June 1961).

21325 HEATING OF LIQUID HYDROGEN FROM NUCLEAR RADIATION. W. G. Thompson and C. G. Johnson (Convair, San Diego, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 165-6(June 1961).

21326 ELECTRIC CONDUCTIVITY PHENOMENON IN ANISOTROPIC MEDIA. I. STRONGLY CONVERGENT SOLUTIONS OF LINEAR OPERATOR EQUATIONS, ESPECIALLY OF THE BLOCH INTEGRAL EQUATION. D. Langbein (Universität, Göttingen, Ger.). Z. Physik, 162: 542-56(1961). (In German)

Questions on the strong convergence of approximation solutions of the Bloch integral equation and therefore on the similar convergence of collective electron transport coefficients can be traced back to questions on the monotone convergence of a single integral. In carrying out the variation method equivalent to the integral equation, one obtains strongly convergent approximation solutions when each function φ_μ occurring in the variation addition describes the displacement of $\varphi_{\mu-1}$ under the effect of the collision and magnetic field and φ_1 is equal to the perturbation by the usual external force. Those magnetic field strengths for which the matrix of the collision-magnetic field operator formed with φ_μ has a defect different from zero only are to be excluded. (tr-auth)

21327 ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS. VOLUME XIII. L. Marton, ed. New York, Academic Press, 1960. 464p.

Inelastic collisions between atomic systems, field ionization and field ion microscopy, velocity distribution in electron streams, electron probe microanalysis, and a research review of television camera tubes are treated. Experimental methods and the theory of each topic are presented and the results obtained are given. (N.W.R.)

21328 ADVANCES IN APPLIED MECHANICS. VOLUME VI. H. L. Dryden and Th. von Karman, eds. New York, Academic Press, 1960. 304p.

Five contributions in the field of fluid mechanics are included. The topics cover the boundary layer theory of unsteady laminar flow and a theory with dissociation and ionization, the propagation of shock waves along ducts of varying cross section, the Karman vortex streets, and the similarity and equivalence in compressible flow. In order to describe the flow of a gas in a boundary layer under extreme conditions, the underlying physical principles of the kinetics of gases are applied to the concepts of statistical mechanics. An extensive survey of similarity methods in aerodynamics is given. (N.W.R.)

21329 ELECTROSTATIC PROPULSION. David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. A Selection of Technical Papers based mainly on A Symposium of the American Rocket Society held at U. S. Naval Postgraduate School, Monterey, California, November 3, 4, 1960. Progress in Astronautics and Rocketry. Volume 5. New York, Academic Press, 1961. 588p.

Thirty-four papers taken mainly from A Symposium of the American Rocket Society are presented. The topics covered include ion generation, ion acceleration and impact effects, neutralization, and techniques and testing. Twenty-seven of the papers are covered by separate abstracts. Two were previously abstracted for NSA. (M.C.G.)

21330 EXPERIMENTAL PERFORMANCE OF ION ROCKETS EMPLOYING ELECTRON-BOMBARDMENT ION SOURCES. Harold R. Kaufman and Paul D. Reader (Lewis Research Center, Cleveland). p.3-20 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

An investigation of ion rockets employing electron-bombardment ion sources was conducted. In the course of this investigation, two engines with 10-cm-diameter ion sources were designed, fabricated, and operated for a total time of about 50 hr. A power efficiency of about 70% and a propellant utilization of over 80% were obtained at a specific impulse of 5500 sec with an ion beam current of 0.125 amp. The advantages of mechanical simplicity, reliability, and efficiency make this engine one of the most promising for space propulsion. The capacity to use many propellants is also an advantage of this type of engine although this investigation was limited to mercury. (auth)

21331 THE DUOPLASMATRON: THEORETICAL STUDIES AND EXPERIMENTAL OBSERVATIONS. B. S. Burton, Jr. (Convair, Fort Worth, Tex.). p.21-50 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The Duoplasmatron is especially well-suited for ion propulsion: it has high power efficiency, high ionization efficiency, and may be used with a variety of propellants. In the Duoplasmatron a low-pressure arc discharge is constricted by a baffle placed between the main electrodes. An axial magnetic field between the anode and the baffle further constrains the discharge. The effect of these constraints is to produce greater ionization density than would be obtained in a free arc of like current. The dense plasma which is produced is expelled through an extraction orifice by kinetic and "magnetic" pressures. Positive ions are extracted from a cloud of plasma produced just outside the sources by a suitably applied electric field. Experimental work was concerned mainly with details of the extraction orifice and, to a lesser extent, with cathode development. With a non-magnetic anode and a magnetic field in the extraction space, 60 ma of argon was obtained with 5 kv extraction potential. (auth)

21332 THE DEVELOPMENT OF A NEGATIVE ION SOURCE. R. J. Sunderland, J. R. Radbill, and R. D. Gilpin (Aerojet-General Corp., Azusa, Calif.). p.51-72 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The necessity for "neutralizing" the thrust producing beams generated by an ion engine is discussed. Although it may readily be shown that there are distinct advantages to be obtained by the use of positive and negative ions having the same charge-to-mass ratios, almost all previous

experiments were conducted with positive ions and electrons. As a step toward demonstrating "neutralization" by means of heavy negative ions, a negative ion source based upon the cavity principle was constructed. For efficient ionization, the walls of the cavity must have a work function which is lower than the electron affinity of the atom or molecule to be ionized. Experiments are described in which iodine or sulfur hexafluoride vapor was ionized in cavities having various low work function coatings. The behavior of each coating with respect to attack by these vapors at elevated temperatures, the mass utilization efficiency, and temperature dependence of the ion current are discussed. The mass spectrum of the ions generated when sulfur hexafluoride is admitted into a tantalum cavity was obtained and an explanation of the probable ionization process is given. (auth)

21333 LIQUID METAL DROPLETS FOR HEAVY PARTICLE PROPULSION. Victor E. Krohn, Jr. (Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.). p.73-80 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Charged droplets of liquid metal were produced in sufficient quantity and with charge-to-mass ratios which are adequate for some propulsion applications. Unfortunately, a serious problem remains; namely, the production of large numbers of metal ions along with the droplets under all operating conditions which were tried. (auth)

21334 THEORY OF ION EMISSION FROM POROUS MEDIA. G. M. Nazarian and H. Shelton (Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.). p.91-106 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The concept of a diffusion length was developed in order to predict the ratio of alkali metal atoms to ions evaporated from a porous tungsten surface. The neutral evaporation is that evaporated from the exposed ion-emitting surface and that directly lost from the pores. This latter loss was calculated as the ratio of volume flow to surface flow at the pore exits with the result $(I_v/I_s)_{exit} = (4/3)(a\Delta_a)^2$ where a is the pore radius and Δ_a is a diffusion length defined in terms of the surface diffusion coefficient D_s and surface residence time τ_a of adsorbed alkali atoms, $\Delta_a = (D_s\tau_a)^{1/2}$. Estimates for cesium on tungsten gave $\Delta_a(1000°K) = 650$ microns, $\Delta_a(1600°K) = 2$ microns indicating the need for micron-size pores at the higher temperatures. The phenomena which occur on the ionizing surface were examined to determine the best mode of operation and choice of pore spacing for the attainment of high current densities with negligible neutral evaporation. It was found that the feed should be brought to the level where the surface coverage in the regions most distant from pores is just great enough to emit the space charge limited current density of ions corresponding to the applied voltage and acceleration distance. On the emitting surface the ratio of neutral evaporation to ion emission was given by $(1/24)(2l/\Delta_a)^2$ where 2l is the pore spacing. (auth)

21335 CHARACTERISTICS OF POROUS SURFACE IONIZERS. D. Zuccaro, R. C. Speiser, and J. M. Teem (Electro-Optical Systems, Inc., Pasadena, Calif.). p.107-39 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York Academic Press, 1961.

Ion sources in general, and porous surface ion emitters in particular, can be characterized parametrically by their average ion current density, atom to ion emission ratio (neutral fraction), and the energy required to produce an ion, all obtained under source or non-space-charge-limited conditions. A number of the factors which enter into the calculation of these parameters from the basic surface ionization and diffusion parameters are reviewed on the basis of a model of uniform pore spacing and size suggested by analysis of presently available sintered porous tungsten. The results of these approximate calculations are presented. Some experimental means of determining these parameters which characterize ion sources are reviewed. (auth)

21336 THE EFFECTS OF SURFACE STRUCTURE AND ADSORPTION ON THE IONIZATION EFFICIENCY OF A SURFACE IONIZATION SOURCE. David G. Worden (General Electric Co., Schenectady, N. Y.). p.141-60 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The ion producing capability of a surface ionization ion source is dependent in part on the properties of a solid surface and the gas-solid interactions which occur thereon. The ionization efficiency of a surface is related parametrically to the electron work function of the surface and therefore must reflect the non-uniform character of the work function due to the several different crystal faces exposed on a real surface. The effects of this surface property on the surface ionization efficiency are discussed. An example is given of the ionization of cesium on a polycrystalline tungsten surface to illustrate the possible magnitude of the deviations from the Langmuir-Saha relation. The gross effects of cesium adsorption are well known and are treated frequently in literature concerning surface ionization. Details are lacking in some systems however, and further experimentation is necessary. The methods used currently to study cesium adsorption are discussed. These methods, the pulsed molecular beam method and the alternating field method, yield the adsorption time of cesium directly. Results of measurements of the adsorption time of cesium on polycrystalline molybdenum as a function of temperature indicated a total adsorption energy of 1.79 electron volts. The results of a calculation of the ionization efficiency of an ion source when the accelerating voltage is varying periodically are presented. It is shown how the ionization efficiency of a surface will depend upon the cesium adsorption time and the frequency of the applied voltage. (auth)

21337 MULTIPLE BEAM ION MOTORS. M. P. Ernstene, A. T. Forrester, R. C. Speiser, and R. M. Worlock (Electro-Optical Systems, Inc., Pasadena, Calif.). p.163-74 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Ion motor configurations based on circular porous tungsten ionizers mounted in close packed hexagonal arrays were operated. The accelerating and decelerating electrodes had corresponding multiple circular apertures. The porous ionizers were "back fed" from a cesium vapor supply system controlled by a needle valve. At low voltages, the accel-decel system used followed the 3/2 power current-voltage relationship for constant accel-decel ratios. At constant net acceleration potentials, the current increased monotonically with the total voltage across the accelerating gap. Under the same variation of voltages, the total beam diameter at the collector decreased monotonically with increasing accelerating gap potential producing total spreading angles as small as a few degrees. Currents obtained correspond to perveances for equivalent

single gap accelerating systems as large as 9.4×10^{-3} amp/volt$^{3/2}$ per circular aperture. (auth)

21338 SPACE-CHARGE THEORY FOR ION BEAMS. G. S. Kino and K. J. Harker (Stanford Univ., Calif.). p.175-94 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

A review is given of the analytical methods of deriving space-charge flow solutions which were previously developed. Certain exact solutions in which the ions flow in circular trajectories are discussed, and it is shown that such solutions form a natural accel-decel solution suitable for ion guns to be used for ion propulsion. The advantages and the disadvantages of these exact solutions are discussed. The approach to the problem using paraxial solutions is also described. Such paraxial solutions enable the uniformity of current density at the emitting anode to be adjusted. Analytical methods of electrode design are discussed, and it is shown how electrodes can be derived for any analytical space-charge flow solution. (auth)

21339 SPUTTERING DUE TO HIGH VELOCITY ION BOMBARDMENT. Edward T. Pitkin (ASTRO, Van Nuys, Calif.). p.195-202 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The problem of electrode erosion through sputtering under ion bombardment is of current interest in ion rocket design. In order to assess the magnitude of this problem, sputtering yields of copper, molybdenum and tungsten surfaces were measured. A monoenergetic beam of singly charged ions was allowed to impinge on clean, flat surfaces in a vacuum environment at incidence angles of 30 to 90°. Beam kinetic energies of 9 to 39 kev with argon, krypton, and xenon ions were examined. Results demonstrated that sputtering yields are proportional to impinging ion mass and inversely proportional to both incidence angle and target surface hardness. Furthermore, a maximum sputtering yield was exhibited in the 20 to 30 kev region as ion beam energy was steadily increased. (auth)

21340 A THREE DIMENSIONAL CALCULATIONS OF THE EFFECTS OF INSUFFICIENT SPACE CHARGE NEUTRALIZATION ON ION ROCKETS. Oldwig von Roos (California Inst. of Tech., Pasadena). p.219-25 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

A three dimensional calculation of the space charge distribution adjacent to an ion rocket and its influence on the thrust of the vehicle is described. Starting with a set of self consistent equations for the particle densities of both the ions and electrons the contributions to the thrust due to momentum transfer through the surface of the space ship and the effects of image forces are discussed. Two cases are considered particularly. In the first case, electrons and ions are ejected into opposite directions; in the second case, they are ejected into the same direction. The thrust obtained in each case is compared with the nominal thrust (the thrust calculated ignoring space charge effects. (auth)

21341 NUMERICAL TECHNIQUES IN THE CALCULATION OF EFFECTS OF INSUFFICIENT SPACE CHARGE NEUTRALIZATION ON ION ROCKETS. P. R. Peabody (California Inst. of Tech., Pasadena). p.227-30 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The algorithm for the numerical solution of the steady state ion propulsion model described by O. von Roos is described. The integral coupling between particle densities and potential was broken by forcing a solution through successive approximations. The obvious finite difference analog to the density equations is singular when the radial velocity is zero, necessitating use of constant-density characteristics, which are the particle trajectories, in the numerical calculations. Densities of outgoing trajectories on a sequence of spherical shells were first obtained, with information about the trajectories which turn back retained and used in generating densities of returning trajectories on the same sequence of shells. Calculations were made on an IBM Type 7090 EDPM. Computing time for an iteration is given. (auth)

21342 JUSTIFICATION OF THE USE OF THE COLLISIONLESS BOLTZMANN EQUATION FOR ION BEAM NEUTRALIZATION STUDIES. W. K. R. Watson (Electro-Optical Systems, Inc., Pasadena). p.231-5 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The use of the collisionless Boltzmann equation for ion beam neutralization studies is discussed. The justification of the use of this equation for ion beam neutralization calculations is shown to consist in evaluating the plasma expansion parameter and insuring that its value is considerably smaller than unity. It was concluded that the equation describes the correct physical properties of the ion beam electron system to within 1% with the worst possible choice of parameters. (M.C.G.)

21343 CIRCULAR BEAM NEUTRALIZATION. Park French (Thompson Ramo Wooldridge, Inc., Cleveland). p.237-49 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

A method of neutralizing a uniform velocity ion beam of circular cross section is presented. In this method, electrons are introduced into the beam so as to travel in spiral paths along the beam. An analysis was made to determine the necessary injection conditions and subsequent beam behavior. For this analysis a beam of initially uniform ion density was chosen. The behavior of the neutralized beam with respect to errors in injection potential and angle was investigated. These errors were found to produce radial oscillation having a frequency twice that of the electron revolution about the beam axis. The behavior of the beam at large distances was analyzed neglecting the effects of particle collisions. The beam was found to expand slowly, asymptotically approaching a conical shape at large distances. An investigation was made into the effects of the thermal velocities of the electrons injected into the beam. It was found that variations in the electron charge densities at injection establish plasma oscillations in the beam which, in turn, aid in the neutralization process. (auth)

21344 AN ELECTROGASDYNAMIC APPROACH TO THE ION JET CHARGE NEUTRALIZATION PROBLEM. W. D. Halverson (General Motors Corp., Indianapolis), H. M. DeGroff, and R. A. Holmes. p.251-74 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The problem of charge neutralization in the exhaust jet of electrostatic rockets was analyzed. The one-dimensional equations of positive and negative space charge flow were developed in which "pressure" terms represent the effect of microscopic interactions between particles. Solutions of the special case of electron flow in constant velocity ion

streams were compared for isothermal and adiabatic electron flow. Two solution types were found which may satisfy neutralization requirements. The possibility of discontinuous solutions is discussed, and preliminary results of a study of positive ion mobility are reported. (auth)

21345 NEUTRALIZATION OF ION BEAMS FOR PROPULSION BY ELECTRON TRAP FORMATION. G. C. Baldwin (General Electric Co., Schenectady, N. Y.). p.275-304 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Beam neutralization is an essential feature of any electrostatic propulsion device, since it prevents rapid charging of the space vehicle capacitance, and eliminates space charge fields, which are especially troublesome near the accelerator aperture. It is desirable to effect neutralization by means which minimize energy losses not associated with thrust. The second function may be performed by a stationary cloud of electrons which can be retained by positive ion space charge in a drift space between the ion gun exit aperture and an auxiliary drift electrode; it can be shown that electrons introduced into this region should, on the average, exchange sufficient momentum in low-angle Coulomb scattering collisions with ions to insure trapping, and will therefore accumulate until they have completely neutralized the region. This constitutes an electron reservoir from which the current required to maintain vehicle neutrality can be supplied. If electrons drawn from the drift region are continually replenished at the correct rate, this region can be regarded as equivalent to a plane emission-limited electron source. A steady state is then possible, in which the potential of the filled electron trap region remains slightly negative, and electrons flow smoothly out with the ion beam. Since it can be shown that the ejected beam constitutes a resistive load on the vehicle capacitance, and that the period of permissible oscillations within the trap is very short compared with the ion transit time, no instabilities are expected. Test of a neutralization method requires complete electrical isolation of the system; this makes it difficult to perform a conclusive demonstration in the laboratory, since the beam catcher constitutes an additional electrode which can create an electron trap. (auth)

21346 NEUTRALIZATION OF ION BEAMS. J. E. Etter, S. L. Eilenberg, M. R. Currie, and G. R. Brewer (Hughes Research Labs., Malibu, Calif.). p.357-72 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Experiments are described in which a cylindrical cesium ion beam is space charge neutralized by injection of electrons at the beam periphery. A configuration of potential was created in the ion gun which trapped electrons from the external source and released them into the ion beam exhaust. Absence of ion beam spread due to space charge forces was taken as the criterium for neutralization and measured current density profiles along the beam are presented with and without the injected electrons. Several mechanisms to account for electron behavior in the trap region which would result in an electron current of the proper velocity and density to neutralize the ion beam are proposed. (auth)

21347 ON ION ROCKET NEUTRALIZATION. Harold Mirels (Lewis Research Center, Cleveland). p.373-81 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Two models, both one-dimensional, of the ion rocket neutralization problem are discussed. The first model assumes that the electrons which neutralize the ion rocket exhaust are emitted with essentially zero velocity from a planar grid and move both upstream and downstream of this grid. The second model assumes that the electrons are emitted with a Maxwellian distribution from an arbitrary downstream electron source. The second model differs from the first in that thermal effects are included, and the geometric shape of the electron source is immaterial. Both models indicate that the downstream location of the electron source is not critical with regard to neutralization. The implications of these models, with regard to three-dimensional ion rocket neutralization, are also discussed. It is concluded that electron thermal motion is not a problem in ion rocket neutralization. (auth)

21348 PRESENT STATUS OF THE BEAM NEUTRALIZATION PROBLEM. Robert N. Seitz, Russell Shelton, and Ernst Stuhlinger (George C. Marshall Space Flight Center, Huntsville, Ala.). p.383-422 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The basic relations governing the flow of charged particles between parallel plates are discussed. Their application to the ion engine makes the requirement for space charge neutralization obvious. Several theoretical approaches to the problem of neutralization by admixture of electrons and ions are described under the varying assumptions of single velocity distribution, Boltzmann distribution, lateral injection, and longitudinal injection. Although the results of theoretical studies and of experiments are encouraging in general, they imply an urgent need for early testing of ion engines under real space conditions. (auth)

21349 THEORY AND APPLICATION OF HOT-WIRE CALORIMETER FOR MEASUREMENT OF ION BEAM POWER. L. V. Baldwin and V. A. Sandborn (Lewis Research Center, Cleveland). p.425-46 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

A very small calorimeter probe (0.001×0.25 cm) for measuring local power density in high energy ion beams was studied both theoretically and experimentally. The hot-wire calorimeter is a probe consisting of a fine, electrically heated wire that responds to ion impingement with a voltage output proportional to the temperature (resistance) change of the wire. The ion and joulean power inputs are balanced by conduction along the wire to cooled supports. A steady-state calibration analysis was supported by experiment. A brief discussion of systematic errors is included. Power density measurements in 12 to 20 kilovolt cesium ion beams are presented as detailed spacial profile and contour maps. Preliminary experiments indicated that the hot-wire calorimeter can consistently repeat ion power density profiles. Furthermore, total beam power data obtained from spacial integration of hot-wire surveys compared reasonably well with data from large calorimeters and ion source meters. An analysis of the transient response of the hot-wire calorimeter was also verified by calibration experiments. The time constant of the hot-wires used in the work was 85 milliseconds, but theoretical designs of tiny calorimeters with about 2 millisecond response are shown to be practical. (auth)

21350 DIAGNOSTICS OF THE SPACE CHARGE NEUTRALIZATION OF ION BEAMS BY ELECTRON INJECTION. David Moore and Phillip Kinzie (Convair, San Diego, Calif.). p.457-71 of "Electrostatic Propulsion."

David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Two probe designs which were found useful in the investigation of mixed ion and electron beams are described. These are: a shielded cup probe which will measure the ion current density and the ion energy distribution, and a thermionic emission probe for determining space potential. Operating procedures and possible sources of error for these probes are discussed. In addition some preliminary studies of beam neutralization by electron injection are given. Space charge neutralization and the control of the space potential within the beam were demonstrated under laboratory conditions. The presence of a considerable number of low energy electrons trapped within the beam even without deliberate electron injection was also indicated. (auth)

21351 ENGINEERING RESEARCH IN ELECTROSTATIC PROPULSION DEVICES. E. N. Petrick (Curtiss-Wright Corp., Quehanna, Penna.). p.473-504 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

Analytical and experimental studies on the surface ionization of cesium are described briefly. Emitters of sintered porous tungsten, photo-etched molybdenum plate, and micro-perforated platinum plate were used. The results of the ionization tests are cited, and agreement is shown between measured ion current and the value predicted from gaseous diffusion data. The engineering aspects of the investigation are directly applicable to the development of electrostatic propulsion devices and are discussed in detail. The pertinent engineering research includes bonding of the emitter to prevent the loss of neutral atoms, corrosion of materials by cesium, and the generation of cesium in situ to reduce the fuel handling problem. The corrosion experiments demonstrated the high-temperature long term suitability of such materials as tungsten, molybdenum, and aluminum oxide. A method of utilizing a refractory metal to braze the emitters into a molybdenum holder is described. The recovery of cesium when cesium chloride was reduced with calcium was 89% of the theoretical value. Based upon the experimental results, recommendations applicable to the development of a compact and reliable ion source system for a long duration electrostatic thrust engine are presented. (auth)

21352 DIFFUSION OF CESIUM AND IONIZATION ON POROUS TUNGSTEN. Otto K. Husmann (Curtiss-Wright Corp., Quehanna, Penna.). p.505-22 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The use of porous materials for alkali ion sources is discussed, based on the experimental evaluation of three samples. To study their behavior, particularly in a temperature range up to 1600°K, helium and argon diffusion rates in the molecular flow range were measured. Below sintering temperature the flow rates were proportional to $T^{-\frac{1}{2}}$. Aging of the sintered tungsten was observed. Slow increase of flow rates over the time of operation and fractures after operation above the sintering temperature showed some limits of these materials. Comparison of the cesium flow rates up to current densities of some hundred $\mu a/cm^2$ showed agreement with the helium calibration. Decrease relative to the calibration toward higher current densities seemed to be affected by fuel migration. At temperatures above 1500°K, molecular flow governed the cesium current densities up to 3 ma/cm^2. Time of operation for each of the tested porous materials exceeded 30 hours. (auth)

21353 TRAJECTORIES AND THRUST-MEASUREMENT TECHNIQUES FOR SPACE TESTING OF ION ROCKET MOTORS. David G. Elliott (California Inst. of Tech., Pasadena). p.523-54 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

In laboratory tests of ion rocket motors the presence of vacuum-chamber walls and residual gas can greatly influence the behavior of the ion-motor exhaust. Hence, final proof of the feasibility of ion motors will probably require actual space tests. The problems of conducting such a space test are discussed from the standpoint of power supplies, attainable thrusts and test durations, suitable trajectories, and thrust-measurement techniques. The simplest thrust-measurement technique was found to be measurement of changes in angular motion. The equations of motion for a body under the influence of a small torque were solved to give the angular motion of an ion-motor test vehicle and show the effects of vehicle configuration. Numerical results are given for attainable angular accelerations, total angular velocity changes, centrifugal forces on the ion motor, and exhaust curvature. The magnitudes of extraneous torques due to the earth's magnetic field and to vehicle elasticity are discussed. Several methods of measuring the angular acceleration produced by the ion motor are presented. An example is given of a specific ion-motor test vehicle employing an ion motor of 10-mlb thrust and launched by a Scout. (auth)

21354 PHYSICS OF THERMOELECTRICITY. A. C. Beer (Battelle Memorial Inst., Columbus, Ohio). p.3-25 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Processes involved in the production of an electric field through the interaction of thermal energy with charge carriers in a solid are reviewed. The techniques of irreversible thermodynamics were applied to phenomenological relationships of general validity. Interpretation of the coefficients connecting the sets of flows and forces in terms of the common thermoelectric quantities was made and the effects of these phenomena on the characteristics of a thermoelectric junction were examined. The kinetic method of the electron theory of solids, based on the use of the Boltzmann equation, was then applied to provide explicit expressions for the transport coefficients. The present status of theoretical understanding is discussed. (auth)

21355 REVIEW OF THE PHYSICS OF THERMIONICS. Wayne B. Nottingham (Massachusetts Inst. of Tech., Cambridge). p.125-31 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Heat may be converted directly to electrical power by means of either the vacuum or the plasma thermionic diode. The latter holds the greater promise of being valuable for space-power applications. The input heat is delivered to the emitting surface and the excess heat is radiated from the cooler electron collecting surface. The efficiency of a device depends on the use of a low work-function collector and a minimum of unwanted heat losses. The best gas for the plasma seems to be cesium which serves to eliminate space charge and conduct the electric current across the diode. Some of the basic concepts related to the plasma diode are presented. (auth)

21356 CESIUM CONVERTER STUDIES. V. C. Wilson (General Electric Research Lab., Schenectady, N. Y.).

p.137-54 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The results of thermionic converter investigations and developments performed by several different investigators are summarized. Curves are presented showing the characteristics of a cesium-vapor-filled converter with a thorium dispenser cathode. These include the effect of varying the cesium pressure, the cathode temperature, the anode temperature, and the effect of an applied axial magnetic field. A method for calculating the potential distribution in this type of converter is proposed. A program was initiated to measure the thermionic emission from cesium films adsorbed on single crystals of a variety of high temperature materials. The results from tantalum single crystals are presented. The design and performance are given for a thermionic converter and radiator combination designed for use with solar energy in outer space. This converter uses a cathode consisting of a partial coating of cesium on tungsten. (auth)

21357 THE PROSPECTS FOR MHD POWER GENERATION. G. W. Sutton and L. Steg (General Electric Co., Philadelphia). p.625-61 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The generation of electric power by passing a conducting fluid through a magnetic field is not a new concept. Recent advances in "low" high temperature technology have generated a number of pertinent theoretical and experimental studies. An attempt is made below to summarize the present situation and to outline some of the more significant problem areas. (auth)

21358 ASPECTS OF MAGNETOHYDRODYNAMIC (MDH) GENERATORS FOR SPACE. J. H. Huth (RAND Corp., Santa Monica, Calif.). p.663-70 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The general characteristics, problems, and work in progress on magnetohydrodynamic (MHD) electrical-power generators are discussed. It was concluded that MHD generators will initially find their main application as a source of short-duration large power pulses. (auth)

21359 EXPERIMENTS RELATING TO GENERATION OF POWER BY MAGNETOHYDRODYNAMICS. Stewart Way (Westinghouse Research Labs., Pittsburgh). p.671-94 "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Some experiments were undertaken to study the problems in magnetohydrodynamic (MHD) power generation when combustion gases are used as the working medium. Furnace oil, mixed with a potassium soap, was burned with oxygen. The stream passed along a 1.6×4.9 inch duct between the poles of a magnet, and with a crossed-field, three-electrode pair arrangement generated power up to about 10.5 kw. Speeds ranged from 500 to 800 meters/sec and static temperatures from 2800 to 3100°K. With various load resistances and field strengths, performance compared fairly well with theory. It was important to guard against electrical leakage and thermal losses. Problems for long time operation center around electrode and side wall durability. The system described was operated for periods up to 10 minutes. (auth)

21360 A VORTEX MHD POWER GENERATOR. R. J. Coerdt (Thompson Ramo Wooldridge, Inc., Cleveland), W. C. Davis, R. T. Craig, and J. E. McCune. p.695-714 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The use of a vortex geometry for the magnetohydrodynamic (MHD) generation of electrical power is discussed. In this device power is extracted from an electrically conductive gas spiraling inward between two stationary electrodes in the presence of a magnetic field. This geometry is a practical application of an earlier work in which the basic solutions were presented for the steady spiral motion of a viscous, electrically conducting gas, moving either inward or outward in the presence of an axial magnetic field between two concentric porous electrodes. Theoretical estimates were made of the possible performance of a vortex MHD power generator. Predictions of the efficiency and operational characteristics are presented, as are methods of calculating the size and weight of such generators. A preliminary prototype unit for experimental studies is described. (auth)

21361 OPTICAL SPECTROMETRIC MEASUREMENTS OF HIGH TEMPERATURES. Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961. 274p. $12.50.

From a symposium devoted essentially to the fields of astrophysics, thermonuclear research, arc research, and shock-tube work, a series of 13 papers are presented. Separate abstracts have been prepared for 11; one was previously abstracted in NSA. The topics provide a critical review of experimental techniques for optical spectrometric procedures for the measurement of high temperatures and of the validity of the theoretical premises in this field of temperature and plasma state. (N.W.R.)

21362 THE MEASUREMENT OF ULTRAHIGH TEMPERATURES. P. C. Thonemann (Princeton Univ., N. J.). p.56-69 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

Spectroscopic techniques and Maxwellian velocity distribution conditions for measuring gas temperatures in excess of 10^4 °K are presented. Binary collisions of electrons with other electrons and ions will be the predominant process leading to a Maxwellian velocity distribution when the energy density of radiation is small. The methods used for measuring electron temperature are bremsstrahlung radiation, radiative recombination, ratio of emission-line intensities, absolute line intensities, and rate of ionization. A summary is presented of each of the above methods. The interpretation of spectroscopic data obtained for the determination of ion temperature is more difficult than that for electrons because mass motion and turbulence contribute to the ionic Doppler broadening. In addition to mass motion, both the random Stark and the Zeeman effects may contribute to the ionic line profiles. These effects are discussed. (N.W.R.)

21363 HIGH-TEMPERATURE STUDIES. W. Lochte-Holtgreven (Universität, Kiel). p.115-24 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

A characterization of high-temperature analysis in plasma research and research concerning stellar atmospheres is briefly discussed. To do this an analysis of a time-resolved spectroscopic observation of a pinch discharge, assuming a constant temperature throughout the plasma, is accomplished. The pressure and temperature are evaluated, followed by the assumption of a model plasma analogous to the model star atmospheres so that the analysis may be refined. The pressure is arranged such that there is thermodynamic equilibrium during the pinch. From this analysis in the laboratory the stellar atmospheres are interpretated. (N.W.R.)

21364 PLASMA-JET TEMPERATURE MEASUREMENT. Willard J. Pearce (General Electric Co., Philadelphia). p.125-69 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

Spectral methods for measuring plasma temperatures from 5000 to 15000°K are evaluated by examining the theories and assumptions involved in each. The most useful method uses the relative intensity of emitted atomic or ionic lines. Such topics as plasma production and its experimental nature are also discussed, including plasma generators, effect of impurities on arc plasma temperatures, equilibrium rates, self-absorption, radial distribution shape factors, and computation of enthalpy and temperature. Experimental results are presented for air plus carbon plasma jet temperature and the spectra from the reference arc. The temperature is determined by three methods for the air plus carbon plasma-jet: the two-line method, the isointentensity-line method, and the general method for more than two lines. The temperature gradients within the plasma jet are also determined. (N.W.R.)

21365 RADIATION FROM INCIDENT AND REFLECTED SHOCKS IN AIR. Bennett Kivel (AVCO-Everett Research Lab., Everett, Mass.). p.197-216 of "Optical Spectrometric Measurements of High Temperatures." Philip Dickerman, ed. Chicago, University of Chicago Press, 1961.

The relaxation behind shocks in air is discussed in terms of the chemical reactions. The spectrographic equipments used and typical measurements are described and discussed. The relation between emitted radiation and the local temperature in the relaxation zone is presented as a problem. When the density of radiating states is in local equilibrium, it is determined by local conditions but depends on a ratio of reaction rates. A summary of typical measurements of radiation from reflected shocks and the determination of absolute radiation rates for some diatomic molecules are also included. (N.W.R.)

21366 MEASUREMENT OF GASEOUS TEMPERATURES BELOW 8,000°K. John G. Phillips (Univ. of California, Berkeley). p.217-31 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

Measurement of temperatures below 8000°K by studies of diatomic molecule spectra produced by emitting or absorbing gases is discussed. Three methods applied to the derivation of a temperature from a molecular spectrum are discussed, rotational, vibrational, and electronic temperatures. They depend largely on the dispersion that can be used, and this is dependent on the intensity of the source and its duration. They are similar to one another and to the kinetic temperature if thermodynamic equilibrium prevails in the source. (N.W.R.)

Astrophysics and Cosmology

21367 ENERGY CONVERSION FOR SPACE POWER. Nathan W. Snyder, ed. A Selection of Technical Papers based mainly on A Symposium of the American Rocket Society held at Santa Monica, California September 27-30, 1960. Progress in Astronautics and Rocketry. Volume 3. New York, Academic Press, 1961. 792p.

Forty-five papers, chiefly selected from A Symposium of the American Rocket Society, are presented. The physics involved in the energy conversion process, nuclear radiation effects, materials problems, advances in photovoltaic cells, the fuel cell, research on dynamic engines, magnetohydrodynamic power generation, and electrostatic generators are discussed. Twenty of the papers are covered by separate abstracts. Seven were previously abstracted for NSA. (M.C.G.)

21368 THE USE OF HIGH TEMPERATURE THERMOELECTRIC MATERIALS (SILICIDES) FOR POWER GENERATION IN SPACE. S. E. Mayer and I. M. Ritchie (Transitron Electronic Corp., Wakefield, Mass.). p.63-72 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The possible use of some developmental high temperature thermoelectric materials, the silicides, for space applications is discussed. Calculations of efficiency and power-weight ratio were carried out for present typical materials and materials which might reasonably be expected to result from present work. It is shown that even though these materials leave a lot to be desired in terms of efficiency, the power-weight ratios are more favorable than other materials industrially available for cases in which the rejected heat can only be lost by radiation. For a given efficiency and Seebeck coefficient for materials having the same efficiency it is shown that the particular combination of parameters in these materials, low electrical resistivity and high thermal conductivity, is the most desirable. (auth)

21369 THERMOELECTRIC ELEMENTS IN SPACE POWER SYSTEMS. Douglas L. Kerr (General Electric Co., Philadelphia). p.85-109 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Some of the characteristics, potentialities, and problems encountered in the design of thermoelectric generators for space applications are discussed. One means of classifying the basic configurations possible is according to the means of rejecting heat from the cold junction, i.e. whether it is to a secondary heat transfer fluid which in turn passes through the radiator or whether the generator waste heat is carried directly to the radiating surfaces by thermal conduction from the cold junctions. Results of some studies which were made of the latter case where the generator is integral with the radiator are presented. Two types of construction were investigated which can be termed the "sandwich" type and the "side fin" type. Estimates of the minimum weight obtainable from each are presented for particular materials properties. Comparison of these indicated that a combination of the two types of construction will result in the least weight. (auth)

21370 THERMOELECTRIC MATERIALS FOR SPACE COOLING. Edward E. Gardner and Edwin L. Woisard (Whirlpool Research Labs., St. Joseph, Mich.). p. 111-21 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Demands which space applications make on thermoelectric materials are discussed as well as the problems inherent in the materials themselves. In particular, properties of n-type and p-type thermoelectric elements belonging to the bismuth telluride class of compounds were examined in terms of various thermoelectric parameters. Other promising thermoelectric materials were also studied. Conclusions were drawn as to the degree to which materials available today meet the demand of space applications and, finally, the outlook for improved materials in the future is discussed. (auth)

21371 VAPOR TURBINE FOR SPACE POWER. Robert O. Bullock (AiResearch Mfg. Co. of Arizona, Phoe-

nix). p.517-39 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Vapor turbines for space power will require the use of unfamiliar fluids in unfamiliar conditions. In order to achieve long life, reliability, and efficiency, attention must be given to problems that previously were either nonexistent or could be economically ignored. Several prominent problems are raised; the background information about them is reviewed, and the research and development required to solve them is outlined. (auth)

21372 STIRLING ENGINE DEVELOPMENT FOR SPACE POWER. M. D. Parker and C. L. Smith. (General Motors Corp., Indianapolis). p.541-64 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The basic Stirling cycle is reviewed with respect to its advantages and limitations for space power applications. An engine design for space power is discussed with particular emphasis on problems associated with the space environment. Conditions for exact balance of dynamic forces are examined. Design and development approach to the lubrication and sealing problems in a zero gravity environment for long periods of unattended operation is outlined. Finally, a Stirling cycle engine is discussed. (auth)

21373 COMPARATIVE RATING OF POSITIVE-DISPLACEMENT ENGINES AND TURBINES FOR CRYOGENIC POWER SYSTEMS. Homer J. Wood (H. J. Wood and Associates, West Los Angeles, Calif.) and Normand E. Morgan. p.565-92 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Expansion engines for space power cycles may be of either turbine or positive-displacement types. Because of fundamentally different machine characteristics, difficulties arise with respect to presenting performance in strictly comparable parameters and in predicting performance when calibrations are available only with working fluids and/or operating conditions differing from those for space vehicle operation. Certain parameters and correlation functions which are of common applicability are presented. It is shown that when properly compared, current piston expansion engines are competitive with turbines. (auth)

21374 AN ELECTRO-MECHANICAL ENERGY STORAGE SYSTEM FOR SPACE APPLICATION. John B. Roes (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.613-22 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The outer space environment in which some energy storage systems now have to operate, and recent advances in inverter technology, have made more attractive the method of mechanical energy storage. A mechanical energy storage system is discussed and the characteristics of a typical example for space application which stores energy in two magnetically suspended flywheels are discussed. The flywheels in the system are the rotors of two counter-rotating, brushless motor-dynamos. The system converts electrical energy into mechanical energy for storage and, after storage, reconverts it for use in the load. The motor-dynamo is of a very efficient air core type which, together with efficient inverters, provides a system with up to 80% over-all efficiency. The capacity of the system is approximately 7 watt-hr/lb for systems with over 500 watt-hr capacity. The reliability of the system is dependent upon the reliability of the electronic control circuits. By proper design of the inverter circuits, peak loads can be absorbed without significant weight being added to the system. Although the system is insensitive to the number of charge-discharge cycles, storage time affects the over-all efficiency because of a small continuous drain of energy to the control circuits during this time. (auth)

21375 HIGH VOLTAGE GENERATION IN SPACE: THE PARAMETRIC ELECTROSTATIC MACHINE. A. S. Denholm, J. G. Trump, and A. J. Gale (Goodrich-High Voltage Astronautics, Inc., Burlington, Mass.). p.745-66 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Electrostatic generators may operate on the principle of charge transport from one electrode to another at a higher potential (Van de Graaff machine), or on the principle of capacitance variations (parametric machine). Where it is desired to use high vacuum to provide the high insulation strengths which are needed, generators operating on the latter principle are attractive because of their simplicity and promise of brushless operation. The development of a reliable variable capacitance generator requires manufacturing to close tolerances and control of vacuum breakdown, spark damage, and field emission. Some promising results which were obtained in the initial stages of a generator feasibility study are described. Theoretical characteristics are compared with those obtained with a small model. (auth)

21376 ELECTROSTATIC GENERATORS IN SPACE POWER SYSTEMS. Dominique Gignoux (Cosmic, Inc., Washington, D. C.). p.767-79 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Designs presently under development for space applications in the 0 to 10 kilowatt range are described. Theoretical calculations of power per unit area of rotor surface are given, and these results are applied to projected designs. Specific powers of 5 kilowatts per pound are anticipated. (auth)

21377 SPACE POWER SYSTEMS. Nathan W. Snyder, ed. A Selection of Technical Papers based mainly on A Symposium of the American Rocket Society held at Santa Monica, California September 27-30, 1960. Progress in Astronautics and Rocketry. Volume 4. New York, Academic Press, 1961. 647p.

Thirty-three papers selected chiefly from A Symposium of the American Rocket Society are presented. The aspects of solar power systems including the work performed for USA space vehicles are discussed. The SNAP program, chemical systems, and space power requirements are also outlined. Five papers are covered by separate abstracts. Fourteen were previously abstracted for NSA. (M.C.G.)

21378 DYNAMIC VERSUS DIRECT CONVERSION. Kenneth P. Johnson (Aerojet-General Nucleonics, San Ramon, Calif.). p.409-32 of "Space Power Systems." Nathan W. Snyder, ed. New York, Academic Press, 1961.

A comparison was made on a lb/kw basis of the performance capabilities of advanced nuclear dynamic and nuclear direct conversion space electric power plants. A dynamic conversion plant uses potassium as a working fluid at a turbine inlet temperature of 1900°F and exhaust temperature of 1300°F. The specific weight of such a plant with shielding is estimated to range from 12.5 to 8.5 lb/kw at a power level of 300 to 2,000 kw(e). The state of the art of thermoelectric conversion is reviewed. It is concluded that because of limited temperature potential and low efficiency, thermoelectrics are not competitive at high power levels. The potential of thermionics with the converters located in the reactor is analyzed. In the thermionic system fuel pins are used as cathodes and the anodes are

cooled by a circulating coolant flowing through the radiator. A theoretical analysis (with cathode and anode emissivity equal to 0.5) indicated that the thermionic concept is competitive with the dynamic system when cathode current densities of 10 amps/sq cm are attained. An analysis of a UC–ZrC reactor (e = 0.8 from LASL experimental data) indicates that it becomes competitive with the dynamic system when a cathode power density of 30 w/sq cm is attained. Low emissivity is necessary in the converter in order to reduce radiant heat losses and maintain good efficiency. Converter efficiency directly affects radiator size and weight. Thermionic converters mounted on the surface of a reactor with no circulating coolant result in a concept which is limited in power level by the geometry of the system. Specific performance (lb/kw(e) is also relatively poor. No attempt is made to evaluate the feasibility, lifetime, reliability, or the development problems inherent in both dynamic and thermionic concepts. (auth)

21379 POWER REQUIREMENTS OF THE NASA SPACE PROGRAM. Harold B. Finger and Fred Schulman (National Aeronautics and Space Administration, Washington, D. C.). p.615-23 of "Space Power Systems." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Power requirements of the NASA space program through 1965 are discussed. Both auxiliary power and propulsive power missions are described. It is shown that auxiliary power requirements were below 300 watts and that power levels of 30 kilowatts and above are under consideration for propulsion purposes. (auth)

21380 FLIGHT VEHICLE POWER FORCASTS. Curtis Kelly (Wright Air Development Div., Wright-Patterson AFB, Ohio). p.625-32 of "Space Power Systems." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Requirements for flight vehicle power dominantly for space applications are forecasted for time references of 1962 and 1966. These forecasts were synthesized and categorized for portrayal on charts. The charts are described and their differences, as a function of time, are pointed out. Similarly, forecasts of optimum application of energy conversion methods are presented and described. Comment is offered on the more significant problems and intriguing aspects of certain specific energy conversion methods. A comparison of the two charts for 1966 is made. (auth)

21381 THEORETICAL ASPECTS OF STELLAR TEMPERATURES. L. H. Aller (Univ. of Michigan, Ann Arbor). p.3-13 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

The temperature of a star may be defined in terms of processes occurring within the stellar atmospheres, for example, ionization, excitation, and dissociation, none of which is fully satisfactory. Until the wavelength range of astronomical observations are increased, the stellar temperature scale will continue to be uncertain at both low and high temperature ends. The most satisfactory temperature is the effective temperature, defined in terms of the total energy output of the star. This quanitity suffers from the disadvantage that it is not directly observable and must be deduced from observable quantities with the aid of model atmospheres. Other theoretical aspects less satisfactory than effective temperature are also discussed and defined. (N.W.R.)

21382 EFFECT OF DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM ON INFERENCES OF STELLAR ATMOSPHERIC TEMPERATURES. Richard N. Thomas (National Bureau of Standards, Boulder, Colo.). p.14-26 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

The analytical structure employed in specifying stellar temperatures from optical spectrometry incorporates two broad assumptions: (1) the temperature of an arbitrary gaseous atmosphere, as inferred wholly from spectrometric analysis, is meaningful, (2) the stellar atmosphere is controlled by radiative processes and rates predominate in fixing such temperature values. Attention is focused on these assumptions in regard to (1) the variety of results obtained when the temperature of an arbitrary high-energy gas is measured, (2) the difference between the classical astrophysical configuration where the diagnosed radiation field reflects the controlling feature of the atmosphere, and (3) the usual laboratory configuration where the diagnosed radiation field reflects a dissipative feature. Illustrations are given of the non-local thermodynamic equilibrium results for an atmosphere in a statistically steady spectroscopic state. (N.W.R.)

Cosmic Radiation

21383 (NYO-9688) THE INFLUENCE OF ISOTOPIC COMPOSITION ON THE MAXIMUM IN THE COSMIC RAY ENERGY SPECTRA. M. V. K. Appa Rao and M. F. Kaplon (Rochester, N. Y. Univ.). May 8, 1961. Contract AT(30-1)-875. 11p.

The maximum often observed at low energies in primary cosmic ray spectra is examined with respect to the possible effect of isotopic composition. It is shown that a maximum can arise if He^3 and He^4 are not distinguished and spectra are plotted on the basis of energy per nucleon instead of rigidity. The discussion is extended to the case of protons, deuterons, and tritons. (D.L.C.)

21384 (PAN-202/VI) ISSLEDOVANIYA YADERNYKH VZAIMODESTVIIV OBLASTI ENERGII ($10^{12} - 10^{14}$) EV NA VYSOTE 50 m NAD UROVNEM MORYA PRI POMOSHCHI USTANOVKI BOL'SHOI PLOSHCHADI. (Investigations of Nuclear Interactions in Energy Interval ($10^{12} - 10^{14}$) eV at the Altitude of 50 m Above Sea Level by Means of the Apparatus of Large Area). Ya. Babetski, Z. Buya, E. Loskevich, E. Massal'ski, B. Nizel, and A. Oles (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 23p.

The apparatus designed for energy measurements of the electron-photon and nuclear-active components of cosmic radiation was composed of four ionizing chamber rows, each with an area of 10 m^2, and layers of lead and graphite. By means of this arrangement the energy spectrum at the altitude of 50 m above sea level was studied. Integral energy spectra are of the power-law character with the exponent 1.5 for the electron-photon component at $2 \cdot 10^{12}$ to $5 \cdot 10^{13}$ ev and with the exponent 1.35 for the nuclear-active component at $3 \cdot 10^{12}$ to $7 \cdot 10^{13}$ ev. The exponent of the spectrum of single nuclear-active particles is 1.8 at 10^{12} to $2 \cdot 10^{13}$ ev. The estimation of energy intervals is connected with some model of interaction and therefore the intervals may be really different from those mentioned by a factor 2. The spectrum of detected μ-mesons is also of power-law character with the exponent $\lesssim 1.9$. (auth)

21385 MEASUREMENT OF COSMIC RAYS BY MEANS OF GEOPHYSICAL ROCKETS. Yu. Shafer and A. V. Yarygin. ARS (Am. Rocket Soc.) J., 31: 715-20(May 1961).

A 1958 cosmic radiation experiment is described in which a rocket containing G-M counters and an ionization cham-

ber is fired to an altitude of 207.4 km. The G-M counters are positioned such that one is coaxial with the rocket and the other is perpendicular to the rocket axis, so that directional effects can be calculated. The proportional counter measures the specific ionization. The mean specific ionization of cosmic particles and the altitude dependence of the cosmic ray intensity are given. (T.F.H.)

21386 LATERAL DENSITY DISTRIBUTION OF CHARGED PARTICLES IN THE CENTRAL REGION OF EXTENSIVE AIR SHOWER. Saburo Miyake, Kensaku Hinotani, Itsuo Katsumata, Tatsunosuke Kaneko, and Nobuo Ito (Osaka City Univ.). J. Phys. Soc. Japan, 16: 847-54 (May 1961).

The lateral density distribution of the ionizing particles around the core of an extensive air shower was observed with ten plastic scintillation counters at mountain altitude (2775 meters above sea level). The lateral density distribution, which has seemed so far to be expressed by the unique function of the distance from the central axis of extensive air showers, is clearized as that it could be expressed by $1/r^n$ approximately is a range of 20 meters from the axis (n varies from 0.8 to 2.0 by the character of each shower). The result seems to have a relation to the fluctuation which was presented in a previous paper or to the fluctuation of nuclear cascade in the development of extensive air showers. The density spectrum at a single counter is also analysed and the result supports this conclusion. (auth)

21387 Mu-MESON COMPONENT OF AIR SHOWER BELOW THE GROUND. Kenji Watanabe (Osaka City Univ.). J. Phys. Soc. Japan, 16: 855-65(May 1961).

The μ meson component, observed underground, of an extensive air shower is studied. The component came from the nuclear cascade of the shower core in the ground and possibly shows a high μ concentration below the ground. The total number can be estimated independently of energy and multiplicity distributions of secondary particles of the elementary collision and also independently of some fluctuations. Experimental data on multiple penetrating particles featuring a high concentration of muons, could not be interpreted in terms of the muons, i.e., decay products within the nuclear cascades in the ground initiated by impinging nucleons of high energy in the air shower cores, even though the possible contribution of the K meson and hyperon production within nuclear cascades is taken into consideration. (auth)

21388 A STUDY ON HIGH-ENERGY NUCLEAR-ACTIVE PARTICLES IN EXTENSIVE AIR SHOWERS. Yasuo Tanaka (Tokyo Univ.). J. Phys. Soc. Japan, 16: 866-80(May 1961).

A new type of detector, transition chamber, was used to study high-energy nuclear-active particles (N-particles) above 10^{11} ev in extensive air showers (EAS) of size above 10^8. The differential energy spectrum of N-particles is shown to be represented by $E_N^{-2.0\pm0.1}dE_N$ up to 3×10^{13} ev irrespective of shower size. The lateral distribution of nuclear-active particles is obtained within 10 m of the axis. This distribution is tentatively explained by a phenomenological model assuming the Maxwell-Boltzmann distribution for the transverse momentum of N-particles. Total number of N-particles of energy $E_N \geq 10^{11}$ ev, N_N, in an extensive air shower is expressed as a function of size N_e by $N_N = (50 \pm 5)(N_e/10^6)^{1.1 \pm 0.1}$, for N_e ranging from 10^5 to more than 10^6. Then the total energy carried by all N-particles of $E_N \geq 10^{11}$ ev is estimated to be as much as that of the electron component in an EAS. On the basis of the observed general relationship between the electron component and N-particles for a wide range of sizes, a model of the development of EAS is suggested. The energy spectrum of N-particles is discussed in relation to that of high-energy γ rays. In particular the existence of very high energy N-particles implies that the average inelasticity $\eta = 0.4$ to 0.5, if they are assumed to be survivors of primary particles. Also the possibilities are discussed for the occurrence of N-particles with energies as much as 10% or more of primary particles. (auth)

21389 A RADIO WAVE MECHANISM TO ACCOUNT FOR THE KNOWN DISTRIBUTION OF VAN ALLEN BELTS ABOUT THE EARTH. Joseph M. Boyer (Northrop Corp., Beverly Hills, Calif.). Nature, 190: 597-9(May 13, 1961).

Theories related to the entrapment of charged particles in the Van Allen belts about the earth due to magnetostatic fields of the earth or sun are reviewed. A theory is presented for predicting the Van Allen belt phenomenon which omits the magnetostatic flux of the sun or earth as a charge-trapping mechanism, but substitutes a radio wave mechanism to account for the known distribution of Van Allen belts. (C.H.)

21390 THE COSMIC-RAY OBSERVATIONS OF DECEMBER 4, 1957. B. G. Wilson (Univ. of Alberta, Calgary, Can.). Nature, 190: 615-16(May 13, 1961).

An 18% increase in the total component of cosmic radiation was reported in Paris on Dec. 4, 1957. A small increase in the nucleonic component at Thule preceded the Paris event by about 3 hrs. No unusual variations were observed in the nuclear components monitored at the Sulphur Mountain Laboratory, near Banff, Alberta, Canada during the period Dec. 3 to 6, 1957. This result is in agreement with other collected data from a large number of stations. It is concluded that the increase reported at Paris was not associated with an injection of solar protons. (C.H.)

21391 MEASUREMENT OF THE COLLISION MEAN FREE PATH OF PENETRATING SHOWER PRODUCING COSMIC RAY NEUTRONS IN LEAD. G. Bózoki, E. Fenyves, and L. Jánossy (Central Research Inst. of Physics, Budapest). Nuclear Phys., 24: 412-21(1961). (In English)

The collision mean free path of penetrating-shower-producing cosmic ray neutrons is measured with an anticoincidence counter arrangment in lead. The detector selects neutrons having a mean energy of about 30 Bev. The collision mean free path and the corresponding collision cross section are found to be $\lambda_c^{Pb} = (208 \pm 12)$ g/cm^2 and $\sigma_i^{Pb} = (1652 \pm 95)$ mb, respectively. From this the inelastic nucleon-nucleon cross section is estimated to be $\bar{\sigma}_1 = (24 \pm 5)$ mb. Comparison of these results with those obtained at accelerator energies shows that the inelastic or collision cross section of neutrons as well as the inelastic nucleon-nucleon cross section in lead very probably remain constant from 1 to about 30 Bev. (auth)

21392 STUDIES ON EXTENSIVE AIR SHOWERS. PART II. SEA LEVEL OBSERVATIONS ON THE FLUCTUATIONS IN THE DENSITIES OF N-PARTICLES, IN SHOWERS OF THE SAME SIZE. B. K. Chatterjee, C. T. Murthy, S. Naranan, B. V. Sreekantan, and M. V. Srinivasa Rao (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 20: 237-45(Apr. 16, 1961). (In English)

A study of the fluctuations in the densities of nuclear (N) particles in extensive air showers is carried out with five N-detectors located at the center of an array of scintillators. Air showers are classified according to their size and the distance of the core from the N-detectors. In each group of showers of given size and core distance, the observed frequency distribution in the number of N detectors activated shows the existence of large fluctuations in the densities of N particles. (auth)

1393 ANGULAR DISTRIBUTION OF SHOWER PARTICLES FROM 1000-BEV NUCLEON ALPHA PARTICLES IN EMULSION NUCLEI. P. L. Jain (Univ. of Buffalo). ays. Rev., 122: 1890-6(June 15, 1961).

Twenty-eight interactions of α particles are located in 22 liter stack of nuclear emulsion by back-tracing shows of minimum ionization particles to their origins. The gular distributions of 17 α particles with a dip angle $\leq 20°$ re presented. The inelasticity for these 17 interactions ows large fluctuations for individual events and its mean lue is 30%. The angular distributions of these α particles e transferred into a system in which they are roughly mmetric. The degree of anisotropy of the angular disibutions is in disagreement with a hydrodynamical model nucleon-nucleus collisions. The detailed analysis of the gular distribution of composite stars for events with a gh degree of anisotropy of secondaries in the center-of-ass system shows that the shape of the angular distribun is in agreement with the predictions of the "two-reball" model of multiple meson production, both for cleon-nucleon and nucleon-nucleus collisions. (auth)

1394 SPALLATION OF INTERSTELLAR MATTER: OSMIC-RAY INTENSITY IN THE PAST. S. N. Milford t. John's Univ., Jamaica, N. Y.), and S. P. Shen. Phys. ev., 122: 1921-2(June 15, 1961).

It is pointed out that spallation of interstellar matter by smic rays occurs, and that the lithium, beryllium, and ron thus produced can be used as rough indexes of the erage interstellar cosmic-ray intensity. Using available ta, this method gives an upper limit of the order of 10 $^{-2}$ sec^{-1} for the intensity of interstellar cosmic rays of netic energy >~50 Mev, averaged temporally over the st few billion years and spatially over several cubic loparsecs in the solar neighborhood. (auth)

1395 OUTLINE OF A THEORY OF MAGNETIC SEPARATION OF AURORAL PARTICLES AND THE ORIGIN OF HE S_d FIELD. J. E. Shaw (Dept. of the Interior, Miller's oint, Sydney). Planetary Space Sci., 2: 49-55(1959).

The diurnal variations of occurrence of two types of spodic E-ionization at Macquarie Island (geomagnetic latide 61.1°S) are identified with the diurnal variations of the ux of incoming protons and electrons. It is shown that otons and electrons, which have been accelerated under e control of the geomagnetic field, will be separated by agnetic forces resulting from their motion along the rved geomagnetic lines of force. The resulting pattern of ecipitation in the atmosphere explains qualitatively the gular diurnal features of the occurrence of sporadic E-nization. An extension of the theory provides a basis for terpretation of the observed development of a visual aural display, with particular reference to the mode of foration of visual auroral forms. The theory explains the igin of the field responsible for the S_D magnetic variations d is in agreement with the spiral occurrence of magnetic sturbance variations previously observed in the north lar regions. (auth)

riticality Studies

396 (DP-532) HANDBOOK OF NUCLEAR SAFETY. gh K. Clark (Du Pont de Nemours (E. I.) & Co. Savannah ver Lab., Aiken, S. C.). Jan. 1961. Contract AT-(07--1. 150p.

Discussions are given of the factors that determine a itical mass, consequences of attaining a critical mass, ory of chain reactions, and margins of safety. Critical d safe conditions are included for the fissionable materials, U-233, U-235, and plutonium, both as pure metals and when alloyed with other metals. Considerations are given for heterogeneously and homogeneously moderated systems, and interactions occurring between units in air and water. (B.O.G.)

21397 (PAN-212/IX) THE CRITICAL PROBLEMS FOR MULTILAYER SLAB SYSTEMS. A. Kuszell (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1961. 27p.

The solution of the critical problems for slab multilayer systems are given by the procedure developed by K. M. Case for one-velocity Boltzmann equation with isotropic scattering of neutrons. In all considered cases the solution of Boltzmann equation is reduced to the solution of one dimensional Fredholm type integral equation with an additional critical condition. (auth)

21398 PULSED NEUTRON MEASUREMENTS OF SUBCRITICAL LATTICES. E. E. Carroll, Jr., N. Hartmann, and D. Klein (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 47(June 1961).

21399 EXPONENTIAL EXPERIMENTS IN URANIUM–DIPHENYL LATTICES. R. W. Campbell, T. L. Guzzle, and R. K. Paschall (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 47-8(June 1961).

21400 BUCKLING MEASUREMENTS OF D_2O MODERATED CLUSTERS OF NATURAL URANIUM OXIDE RODS. N. P. Baumann and E. J. Hennelly (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nuclear Soc., 4: No. 1, 48-9(June 1961).

21401 PRECISION CRITICAL SUBSTITUTION MEASUREMENTS OF BUCKLINGS IN D_2O MODERATED LATTICES. W. E. Graves (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nuclear Soc., 4: No. 1, 49(June 1961).

21402 LATTICE PARAMETER MEASUREMENTS FOR A CONCENTRIC TUBE FUEL ELEMENT. D. E. Wood, K. R. Birney, and E. Z. Block (General Electric Co., Richland, Wash.). Trans. Am. Nuclear Soc., 4: No. 1, 49-50 (June 1961).

21403 k_∞ MEASUREMENTS IN THE PAWLING LATTICE TEST RIG. G. Foster, W. L. Brooks, M. Fleishmann, and R. D. Schamberger (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 51(June 1961).

21404 EXPERIMENTAL AND CALCULATED ACTIVATIONS IN A ONE-DIMENSIONAL SLAB CORE WITH ZIRCONIUM–H_2O REFLECTOR. J. Korsmeyer, C. Bolmgren, and S. Milani (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 51(June 1961).

21405 TECHNIQUE FOR ANALYZING PARTIAL WATER HEIGHT EXPERIMENTS. W. B. Doub and J. E. Mott (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 51-2(June 1961).

21406 REACTIVITY AND ACTIVATION MEASUREMENTS AND CALCULATIONS IN HIGHLY ENRICHED U–Zr–H_2O CRITICAL ASSEMBLIES BETWEEN 65 AND 460°F. L. O. Herwig, W. F. Vogelsang, J. J. Kepes, E. L. Humez, W. A. Vogele, and T. M. Ryan (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 52-3(June 1961).

21407 ANALYTICAL AND EXPERIMENTAL RESULTS FOR A COMPACT, ZIRCONIUM HYDRIDE MODERATED CRITICAL ASSEMBLY. L. I. Moss, C. M. Podeweltz,

R. L. Randall, J. L. Shapiro, and R. E. Wimmer (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 53-4(June 1961).

21408 CRITICAL ARRAYS OF NEUTRON INTERACTING UNITS. L. W. Gilley and J. T. Thomas (Oak Ridge National Lab., Tenn.). Trans. Am. Nuclear Soc., 4: No. 1, 54-5(June 1961).

21409 THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE SEMIHOMOGENEOUS CRITICAL ASSEMBLY. K. Inoue, W. Y. Kato, K. Sumita, M. Iizumi, K. Nishimura, Y. Knaeko, S. Kobayashi, I. Kobayashi, S. Matsura, T. Kurosawa, S. Yasukawa, and T. W. Park (Japan Atomic Energy Research Inst., Tokyo). Trans. Am. Nuclear Soc., 4: No. 1, 56-7(June 1961).

21410 ANALYTICAL TECHNIQUES FOR INTERPRETING EPITHERMAL CRITICAL EXPERIMENTS. A. V. Campsie (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 99-100(June 1961).

Elementary Particles and Radiations

21411 (AFOSR-TN-60-304) ON THE DECAY INTERACTION OF STRANGE PARTICLES. Physics Department Technical Report No. 165. B. Sakita and S. Oneda (Wisconsin. Univ., Madison and Maryland. Univ., College Park). Feb. 1960. Sponsored by AF and AEC under Contract AF49(638)-24. 16p.

This report is a revised version of AECU-4411.

It is proposed that the strength of the coupling constants is different for the strangeness non-conserving and strangeness conserving currents in the scheme of Fermi interactions of an ordinary charged current-current type. First, the consistency with experimental results is analyzed by introducing phenomenologically the direct $\bar{\Lambda}-N$ interaction which satisfies the $|\Delta I| = \frac{1}{2}$ rule in addition to the usually assumed primary Fermi interaction. Then, the possibility of deriving this interaction or the effective interaction of the primary Fermi interaction is discussed. (auth)

21412 (JINR-P-370) ENERGETICHESKIE SPEKTRY ZARYAZHENNYKH P-MEZONOV, OBRAZOVANNYKH V pd-SOUDARENNYAKH PRI 660 MEV. (Energy Spectra of Charged π Mesons Produced in (p-d) Interactions at 660 Mev). V. G. Vovchenko, G. Gel'fer, A. S. Kuznetsov, M. G. Meshcheryakov, and Research: Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 13p.

A magnetic spectrometer was used for measuring the energy spectra of charged π mesons produced in p-d and p-p interactions. The differential cross sections of $p + d \rightarrow \pi^+$, $p + d \rightarrow \pi^-$, and $p + p \rightarrow \pi^+$ processes (cms) are $(5.9 \pm 0.6) \times 10^{-28}$, $(0.57 \pm 0.08) \times 10^{-28}$, and $(6.7 \pm 0.7) \times 10^{-28}$ cm^2/str. The ratio of effective π^+ formation on protons in deuterons and on free protons is 0.79 ± 0.08. (tr-auth)

21413 (JINR-P-384) IZUCHENIE PROTSESSOV FOTOROZHDENIYA S POMOSHCH'UY DISPERSIONNYKH SOOTNOSHENI (Studies of Photo Production by Means of Dispersion Relations). L. D. Solov'ev and G. N. Tentyukova (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1959. 31p.

An accurate numerical solution was found for the static dispersion relation for photoproduction P-amplitudes. A complete formula was derived for the photoproduction amplitude considering 1/m corrections, corrections for accuracy, and supplementary conditions which enable further verification of previously derived S-wave results. The data are correlated with data on π photoproduction. An expression is also found for virtual photoproduction amplitudes describing the $e + n \rightarrow e + n + \pi$ process. Comparisons of the expression with published data on neutron magnetic moment (exponential model) produced the magnitude 1.2×10^{-13} cm (order of accuracy $\lesssim 30\%$). (tr-auth)

21414 (NP-10253) UPRUGOE RASSEYANIE MEZONOV S IMPUL'SOM 2,8 BEV/S NEITRONAMI NAZAD. (Elastic Scattering of π Mesons by Backward Scattering Neutrons at 2.8 Bev/C). Yu. D. Bayukov, G. A. Leksin, D. A. Suchkov, Ya. Ya. Shalamov, and V. A. Shebanov. (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1961. 7p.

A 17-liter freon chamber was used in studies of quasi-elastic $\pi^- - N$ scattering into a backward semi-atmosphere in laboratory coordinater. The cross sections for a mean nuclear mixture (F) was <0.1 mb. For a free nucleon the total cross section for elastic scattering was <0.02 mb at angles 140 to 180° (cms). The results are correlated with a theoretical evaluation. (R.V.J.)

21415 (NP-10254) STENOGRAMMA 1-13 LEKTSII PO SLABYM VZAIMODEISTVIYAM. (Stenographic Report of the Lectures 1-13 on the Theory of Weak Interactions). L. B. Okun (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1960-1961. 189p.

Conservation laws, selection rules and conservation, elementary particle theory, and especially the theory of weak interactions are analyzed in 13 lectures. The first introductory lecture is followed by lectures on weak interactions; μ-meson decay; the structure of weak interactions; charge conjugation; inversion coordinates and time conversion; C, P, and T transformation; lepton decay of strongly interacting particles; lepton decay with conservation of strangeness; lepton decay of strongly interacting particles and isotopic parity; lepton decay retaining strangeness; and lepton decay of strange particles with variations of strangeness. (R.V.J.)

21416 (NP-10286). INVESTIGATION OF Σ-HYPERON DECAYS. Technical Report No. 24. G. Condo, J. E. Crew, R. D. Hill, and M. A. Ali (Illinois. Univ., Urbana). May 1961. Contract ONR 1834(05). 10p.

A search was made for Σ^- leptonic decays predicted by Feynman and Gell-Mann on the basis of a universal Fermi interaction. A stack of emulsion strips was exposed to the unenriched Berkely K^- beam. Approximately 2,300 K^- star were found. A charged Σ hyperon was observed from 16.9 9% of all K stars. Of the 160 Σ^+ decays, 79 were decays into a π^+ and 81 into a proton. All 75 Σ^- events were identified by the presence of an Auger electron. No evidence for electronic deacy of Σ was found. On the basis of the Feynmann and Gell-Mann prediction, two electronic decays were expected from that sample of Σ^- hyperons. The negative result agreed with other experiments indicating that the leptonic decay rate is appreciably below the theoretical prediction. (M.C.G.)

21417 (NYO-9686) THE PROTON-PROTON TRIPLE SCATTERING PARAMETERS R AND A AT 213 MEV. Alan C. England, William A. Givson, Kazuo Gotow, Ernst Heer, and John Tinlot (Rochester, N. Y. Univ.). Apr. 17, 1961. Contract AT(30-1)-875. 55p.

As a part of a program to determine the p-p scattering matrix at 213 Mev, the triple scattering parameters R and A were measured at 30, 40, 50, 60, 70, 80, and 90° in the center-of-mass system. The results are compared with a

ase-shift analysis by MacGregor and Moravcsik and with e predictions of the boundary condition model of Saylor, ryan, and Marshak. (auth)

1418 (NYO-9744) REMARK ON THE RADIATIVE UON DECAY IN THE THEORY WITH AN INTERMEDIATE ECTOR MESON. Z. Bialynicka-Birula (Rochester, N. Y. niv.). May 16, 1961. Contract AT(30-1)-875. 5p.

The problem of explaining the lack of radiative muon ecay in an intermediate charged vector meson theory is scussed. A possible way of introducing the charged ector meson to the theory of weak interactions is outned in which renormalization is retained. However, if is way is used, the anomalous magnetic moment is calulated to be large, which is in contradiction with expectaons. (D.L.C.)

1419 (PAN-214/VII) ON THE ANGULAR MOMENTUM EIGHT FACTOR IN THE STATISTICAL THEORY OF ULTIPLE PARTICLE PRODUCTION. PART I. Z. Koba olish Academy of Sciences. Inst. of Nuclear Research, arsaw). Feb. 1961. 10p.

General properties, methods of evaluation, and a recurence formula of the angular momentum weight factor $_nD(l_1, l_2, \ldots, l_n)$ is described, which plays an essential ole in the statistical treatment of the multiple particle roduction with angular momentum conservation. (auth)

1420 (TID-12795) SYSTEMATICS OF ENERGIES OF TATES OF ELEMENTARY PARTICLES. David Garelick Massachusetts Inst. of Tech., Cambridge. Lab. for Nulear Science). May 19, 1961. Contract AT(30-1)-2098. p.

Considerations are given for the systematics of energies f states in which only baryons and mesons are present. nergy spacings of the baryon and meson states are shown raphically. (B.O.G.)

1421 (UCRL-9322) MOMENTUM DEPENDENCE OF HE ASYMMETRY IN MUON DECAY (thesis). Hans ruger (California. Univ., Berkeley. Lawrence Radiaon Lab.). Feb. 2, 1961. Contract W-7405-eng-48. 81p.

Positive muons from the Berkeley 184-in. synchrocyclotron were stopped in various materials and the momentum ependence of the asymmetry of positrons from their decay easured with a magnetic spectrometer. The parameters f the polarized muon spectrum, determined by leastquares fitting the theoretical form of the asymmetry to s measured values, are $\rho = 0.774 \pm 0.042$, $\delta = 0.782 \pm .031$, $|\xi| \geq R|\xi| = 0.848 \pm 0.036$ for an unrestricted local uon decay interaction, where R is the effective muoneam polarization. These values of the parameters include adiative corrections and corrections for bremsstrahlung nd all instrumental effects. When the local muon decay ineraction with four-component neutrinos is restricted to $g_T = -g'_T$ and to complete positron polarization, these valies of ρ and δ imply $|\xi| = 0.989 \pm 0.014$ for any degree of epton conservation. This value of $|\xi|$ implies that the averge muon-beam polarization during this experiment was R = .857 ± 0.024. The value $\rho/\delta = 0.985 \pm 0.056$ was obtained ndependently from the ratio of the asymmetry at x = 1.0 nd x = 0.75, where x is the total positron energy in units f the maximum positron energy. This determination asumes only locality and $|\eta| \ll 1$, and it holds for any degree f lepton conservation. The smallness of the deviations of ne parameters from their values in the local two-component eutrino theory with lepton conservation places an upper imit of about 4% on a possible violation of the leptonconservation rule, or restricts the radius of a possible onlocal interaction propagated by intermediary particles o $(0.54 \pm 0.90) \times 10^{-13}$ cm and the mass of these particles to $\gtrsim 220$ Mev. Thus the measured parameter values are compatible with a local two-component neutrino theory with complete lepton conservation and with 100% positron polarization, i.e., the V−A interaction. For this interaction the measured value of $R|\xi|$ implies $|\eta| \leq 0.27 \pm 0.03$. (auth)

21422 A POSSIBLE REGULARITY FOR THE MASSES OF MESONS AND BARYONS. A. Mihul and E. Mihul (Joint Inst. for Nuclear Research, Dubna, USSR). Acad. rep. populare Romîne, inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 983-8(1960). (In Rumanian)

Some empirical and semi-empirical formulas concerning the masses of elementary particles are discussed. A new empirical formula for the masses of mesons, baryons, and their antiparticles is proposed based on the observation that the increase of strangeness is concomitant with the increase of the mass of the particle. The constants should be selected so that the formula considered will give as exactly as possible the respective masses. The formula proposed contains 9 constants. (tr-auth)

21423 THE PION-PION INTERACTION IN τ DECAY. E. Lomon (Massachusetts Inst. of Tech., Cambridge), S. Morris, E. J. Irwin, Jr., and T. Truong. Ann. Phys. (N. Y.), 13: 359-78(June 1961).

The momentum dependence of the τ-decay rate deviates considerably from that predicted by the relativistic phase space factor and Coulomb corrections. The difference is attributed to the final state pion-pion interaction. Three different phenomenological analyses are made to determine the T = 0 and T = 2 s-state pion-pion force required for consistency with τ and τ' data. These analyses include a scattering length approximation, an independent pair approximation for an exponential potential, and a Born approximation for a Yukawa potential. The results of all three approximations agree where they are applicable and indicate a weak or repulsive T = 0 force and an attractive T = 2 force. (auth)

21424 THE INFRARED DIVERGENCE PHENOMENA AND HIGH-ENERGY PROCESSES. D. R. Yennie (Univ. of Minnesota, Minneapolis), S. C. Frautschi, and H. Suura. Ann. Phys. (N. Y.), 13: 379-452(June 1961)

A treatment of the infrared divergence problem in quantum electrodynamics is given. The infrared divergences are separated as multiplicative factors, which are treated to all orders of perturbation theory, and the residual perturbation expansion is converted into one that has no infrared divergence, and hence no need for an infrared cutoff. In the infrared factors, which are exponential in form, the infrared divergences arising from the real and virtual photons cancel out in the usual way. These factors can then be expressed solely in terms of the momenta of the initial and final charged particles and an integral over the region of phase space available to the undetected photons; the factors do not depend upon the specific details of the interaction. Electron scattering from a static potential is treated, and several other examples are discussed. It is found that when the infrared contributions are separated in a particular way, they dominate the radioactive corrections at high energies and together with certain "magnetic terms" and vacuum polarization corrections seem to give all the contributions proportional to ln (E/m). All of these corrections can be easily estimated (in most cases) simply from a knowledge of the external momenta of the charged particles; this then provides a very accurate way of estimating radiative corrections to high-energy processes. (auth)

21425 INVESTIGATION OF THE STABLE CIRCULAR MOTION OF A RADIATING CHARGE IN THE BETATRON

FIELD. Ernst Schmutzer (Universität, Jena, Ger.). Ann. Physik (7), 7: 251-7(1961). (In German)

The approximate conditions which result from the requirement that a point charge radiating continuous energy move in a constant circle were investigated. As a basis for calculating the motion pattern and the radiation, the Dirac classical relativistic motion equation of a radiating point charge was used. An explicit relationship between particle velocity and the magnetic field was established by applying the Wideroe condition in integrating the complex motion equations. The time pattern of these magnitudes is also given. The problematics is principally of theoretical interest. (tr-auth)

21426 THE EFFECT OF THE ELECTRON SHELL OF THE SCATTERING ATOM ON THE ASYMMETRY EFFECT. T. Tietz (Univ. of Łodź, Poland). Ann. Physik (7), 7: 258-62(1961). (In German)

The method developed for calculating the scattering of fast electrons at a Thomas-Fermi force field can be applied to the investigation of the effect of the electron shell of the scattering atom on the asymmetry effect. (tr-auth)

21427 THE EFFECT OF THE ELECTRON SHELL ON THE BREMSSTRAHLUNG IN THE HARTREE AND THOMAS-FERMI THEORY OF THE ATOM. T. Tietz (Univ. of Łodź, Poland). Ann. Physik (7), 7: 263-7(1961). (In German)

The effect of the electron shell on the non-relativistic theory of the continuous x-ray spectrum was investigated. Closed expressions for the intensity of the unpolarized radiation, for the total energy emitted in the frequency interval, and the total energy emitted in the bremsstrahlung process were derived. The transition of these expressions to the case of the pure Coulomb field was investigated. (tr-auth)

21428 NEAR-ZONE BACK-SCATTERING FROM LARGE SPHERES. V. H. Weston (Univ. of Michigan, Ann Arbor). Appl. Sci. Research, B, 9: 107-16(1961). (In English)

For an incident electromagnetic plane wave, the near-zone behavior of the backscattered field produced by a perfectly conducting sphere is investigated for small wavelengths. The backscattered cross section becomes appreciably different when the receiver approaches to within a distance of several radii from the center of the sphere, and in fact becomes the cross section of a flat plate for the receiver very near the sphere. (auth)

21429 FRACTION OF RADIATION EMERGING FROM A HOLLOW CYLINDRICAL SOURCE FILLED WITH ABSORBING SUBSTANCE. E. (Ye) E. (Ye) Kovalev and D. P. Osanov. Biophysics (U.S.S.R.) (English Translation), 5: 716-19(1960).

Calculations were made of the fraction of radiation emerging from a hollow cylindrical source filled with absorbing substance in relation to the relative dimensions of the source and the distance to a given point. Assumptions used in the calculations are outlined and results are discussed. (C.H.)

21430 DOSIMETRY OF RADIATION OF PULSED X-RAY TUBES WITH AUTOELECTRONIC EMISSION AND THE POSSIBILITY OF THEIR USE IN RADIOBIOLOGY. A. A. Zotikov (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: 720-3(1960).

Measurements were made of the radiation dose from pulsed x-ray tubes with autoelectronic emission from the cold cathode. Possible applications as a source of high dose rate for radiobiological studies are discussed. (C.H.)

21431 APPROXIMATE FORMULAS FOR THE DIFFRACTED ELECTROMAGNETIC WAVE. [PART] II. B. Karczewski (Inst. of Physics, Polish Academy of Sciences). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 8: 767-72(1960). (In English)

Equations for finding the electric and magnetic field strength near the shadow boundary are derived and proved. Comparison of the stationary phase method with Senior's theory is also accomplished. The main use of these equations is for computing the intensity of a plane electromagnetic wave which is diffracted on the edge of the boundary of geometrical shadow from Kottler's theory. (N.W.R.)

21432 ONE-PARTICLE GREEN'S FUNCTION IN THE SPINOR SPACE. J. Rzewuski (Univ. of Wrocław, Poland and Inst. of Physics, Polish Academy of Sciences, Wrocław, Poland). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 8: 777-82(1960). (In English)

The solutions of the second order invariant differential equation in spinor space are investigated with respect to their correspondence to the solutions of one-particle problems in quantum field theory. It is found that the manifold of solutions of linear equations in spinor space contains functions which correspond to solutions of non-linear equations in Minkowski's space. This seems to offer a new approach to the problem of interaction. (auth)

21433 TWO-PARTICLE GREEN'S FUNCTION IN THE SPINOR SPACE. J. Rzewuski (Univ. of Wrocław, Poland and Inst. of Physics, Polish Academy of Sciences, Wrocław, Poland). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 8: 783-7(1960). (In English)

The solutions of a system of second order invariant differential equations in spinor space are investigated with respect to their correspondence to the solutions of two-particle problems in quantum field theory. It is shown that the manifold of solutions of linear equations in spinor space contains functions which correspond to the two-particle Green's functions in Minkowski's space. (auth)

21434 THE GLOBAL SYMMETRY IN WEAK INTERACTIONS. J. Lukierski (Univ. of Wrocław, Poland). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 8: 803-6(1960). (In English).

The invariance property of weak interactions under the simultaneous interchanges $p \rightarrow \nu$, $n \rightarrow e^-$, $\Lambda \rightarrow \mu^-$, together with another symmetry $p \rightarrow \nu$, $n \rightarrow \mu^-$, $\Lambda \rightarrow e^-$ is explained with the help of the universal neutrino charge N, which describes the weak interaction. It is assumed that the neutrino charge gauge is realized on four-spinors by means of the Nishijima transformations. It is proved that $e \rightarrow \mu$ and that the neutrino charge hypothesis is useful for the elimination of the unobservable processes. (N.W.R.)

21435 K^+-PROTON SCATTERING IN A CASE OF SCALAR COUPLING. M. Świecki and M. Szalek (Inst. of Physics, Polish Academy of Sciences, Warsaw and Univ. of Warsaw). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 8: 807-10(1960). (In English)

The problem of K^+-scattering in the Tamm-Dancoff approximation is considered. The coupling between K mesons and baryons is assumed to be scalar. The $S_{1/2}$ phase shift and the total cross section are presented. The $P_{1/2}$ and $P_{3/2}$ waves are discussed in the low-energy approximation. The possibilities of $S_{1/2}$ resonance are considered. The results obtained do not agree with experimental data, suggesting that the coupling is not scalar. (auth)

21436 A GENERALIZATION OF THE FOLDY-WOUTHUYSEN TRANSFORMATION TO PARTICLES WITH ANY SPIN WITHOUT EXTERIOR FIELD AND

OME APPLICATIONS. M. Baktavatsalou. Compt. nd., 252: 2824-6(May 8, 1961). (In French)
It is shown that the general Foldy-Wouthuysen trans- rmation for a particle of any spin is obtained from dif- rent elementary transformations corresponding each to e particle of spin $\hbar/2$. It was applied to hamiltonian and osition operators. The last result was compared with that Newton-Wigner. (tr-auth)

1437 EXISTENCE OF A "HARD CORE" FOR NU- LEON-NUCLEON INTERACTION IN HEITLER-ARNOUS ON-LOCAL THEORY. Yvonne Héno. Compt. rend., 252: 27-9(May 8, 1961). (In French)
The Heitler-Arnous non-local interaction theory is ap- ied to the treatment of the interaction between nucleons. second-order calculation leads to the existence of a ard core" whose radius is in agreement with the experi- ental results. (tr-auth)

1438 A POSSIBLE EXTENSION OF THE METHOD OF UASI-REAL PROCESSES TO THE MESON THEORY. Paul essler and Alix Jacquemin. Compt. rend., 252: 2830-2 lay 8, 1961). (In French)
The method of quasi-real processes is applied to the ele- entary Feynman diagram corresponding to the emission a π meson by a relativistic nucleon. (tr-auth)

1439 THE LEVEL STRUCTURE AND ELECTRO- AGNETIC STRUCTURE OF THE NUCLEON. Masaaki ato and Gyo Takeda (Tokyo Univ.). Fortschr. Physik, 51-105(1961). (In English)
The nucleon (N) excited state energy levels are found om π-N scattering resonances. The meson theory is ed to explain these resonances in terms of incoming nucleonic π resonances. The optical properties of the ucleon in meson theory are outlined. The isovector and oscalar contributions to the nucleon electromagnetic ructure are detailed. The problem of determining the nge of the electromagnetic structure (e.g., by e-N scat- ring) is discussed. (T.F.H.)

1440 AN EXPERIMENTAL STUDY OF GAMMA-RAY ENETRATION THROUGH A PIPE. Tomonori Hyodo and suyoshi Okumura (Kyoto Univ.). J. At. Energy Soc. pan, 3: 284-7(Apr. 1961). (In Japanese)
The penetration of gamma rays through a metal pipe measured. A lead pipe is used with an inner diameter D.) of 5.0 cm, and iron tubes are used with I.D.'s of 5.0 n and 9.6 cm. Cs^{137} and Co^{60} point gamma ray sources e placed on the tube axis. The gamma rays that pass rough the tube and are scattered from the wall of the be are detected by a NaI(Tl) scintillator. Energy spectra scattered gamma rays are measured at several source sitions, and energy and number build-up factors are ob- ined from the spectra. (auth)

1441 STOPPING POWER OF GOLD FOR 14.36-Mev LPHA PARTICLES. C. Gerardin, R. Bilwes, and . Magnac-Valette (C.R.N., Strasbourg-Cronenbourg, rance). J. phys. radium, 22: 62-4(Jan. 1961). (In rench)
The residual energy of 14.36-Mev α particles after pas- ge through gold foils of various thicknesses was meas- red using a magnetic spectrograph and a Van de Graaff enerator. The calibration curve of the spectrograph is ven. It was determined that the relative error on the en- gy of the α particles without absorbant is 4.5×10^{-3}. The ariation of the thickness of the absorbant in mg/cm^2 was etermined as a function of the residual energy E_f. The th energy curve is then obtained. The slope of this curve coincides with the Whaling except for two points, one at 9.61 and 9.85 Mev. (J.S.R.)

21442 RESONANCE IN MESON π–MESON π SCATTERING AND THE ABNORMAL MAGNETIC MOMENT OF THE μ MESON. Claude Bouchiat and Louis Michel (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 121 (Feb. 1961). (In French)
The presence of a resonance in the state J = 1, T = 1, suggested by a study of the electromagnetic structure of nucleons, is shown in the vacuum polarization for pulse energy transfers in the vicinity of the resonance. Brown and Calogero (Phys. Rev. Letters, 4: 315(1960)), after establishing explicitly the relation between the form factor of mesons and the propagation of photons, have calculated the effect of the $\pi-\pi$ resonance in e–e and $e-e^+$ scattering at high energy. In the present study the effect of this resonance on the magnetic moment of the μ meson is calculated. The value found, of the order of 10^{-7}, would be difficult to measure experimentally. (J.S.R.)

21443 SOME INTRINSIC SYMMETRICAL PROPERTIES WITH RESPECT TO THE INVERSION GROUP IN PARTICLE THEORIES AND THE SPIN-STATISTIC RATIO. K. H. Tzou (Institut Henri Poincaré, Paris). J. phys. radium, 22: 142-8 (Mar. 1961). (In French)
In the general theories of particles some intrinsic symmetry properties of certain matrix operators in connection with each of the inversion operations are studied. With the aid of these intrinsic properties, it is shown that the antiunitary-unitary inversions or the unitary-antiunitary ones can all determine the statistics of elementary particles according to their spin, if the invariance of the field quantization rules under any one of the operations is postulated. The unitary-unitary inversions or the antiunitary-antiunitary ones, on the contrary, are incapable for the determination of particle statistics. It is particularly remarked that the CPTM invariance, like the CPT invariance, is not an automatic invariance in quantum theory of fields; they are assured in this case only when elementary particles obey their respective good statistics according to their spin. (auth)

21444 APPLICATION OF THE FOLDY-WOUTHUYSEN TRANSFORMATION TO SOME CASES OF INTERACTIONS BETWEEN ELECTRON AND ELECTROMAGNETIC FIELD. M. Baktavatsalou (Institut Henri Poincaré, Paris). J. phys. radium, 22: 159-64(Mar. 1961). (In French)
A general expression to the 4th approximation $(1/m)^4$ for the Dirac Hamiltonian without odd matrices is given, using the Foldy-Wouthuysen method. The interaction is then discussed in the following three cases: a) static magnetic field; b) static electric field; and c) electromagnetic field varying with time and satisfying Maxwell-Lorentz equations. The physical interpretation of the different terms obtained from the final result is also discussed. (auth)

21445 INTERACTIONS BETWEEN GRAVITON AND ELECTRON IN FUNCTIONAL THEORY. Pham Xuan Yem (Institut Henri Poincaré, Paris). J. phys. radium, 22: 165-8(Mar. 1961). (In French)
The interactions between an electron and a graviton are expressed by the coupling terms in the equations of those two types of particles. The action of the electron in the gravitational equations is represented in terms of its energy-momentum tensor. Conversely, the potentials of the gravitational field associated with the graviton will react upon the movement of the electron. (auth)

21446 A CONVERGENT SET OF INTEGRAL EQUATIONS FOR SINGLET PROTON-PROTON SCATTERING.

S. Ciulli and J. Fischer (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 24: 465-73(1961). (In English)

Elastic nucleon-nucleon scattering is studied by using the two dimensional spectral representation of Mandelstam. The convergence problem arising from the combination of the forward dispersion relation with the unitarity condition on the physical cut is solved via a conformal transformation. (auth)

21447 THE $^1S_0$ NUCLEON INTERACTION IN THE BOUNDARY CONDITION MODEL. E. L. Lomon (Massachusetts Inst. of Tech., Cambridge) and M. Nauenberg. Nuclear Phys., 24: 474-9(1961). (In English)

The nucleon-nucleon interaction model consisting of an energy independent boundary condition with an exponential potential tail is solved analytically for S states. The range of the potential is chosen to be approximately half of a meson Compton wavelength. The three remaining model parameters are fitted to the $^1S_0$ scattering length, effective range, and 210 Mev phase shift. The strength of potential required is in agreement with the expectations of a meson theory. Phase shifts are predicted at other energies between 0 and 310 Mev. (auth)

21448 ASYMMETRY OF THE ANGULAR DISTRIBUTION OF ELECTRONS FROM $\mu \rightarrow e-$DECAY. I. I. Gurevich, B. A. Nikolskii (Nikolsky), and S. A. Ali-Zade (Kurchatov Atomic Energy Inst., Moscow). Nuclear Phys., 24: 480-7(1961). (In English)

The asymmetry of the angular distribution of electrons from $\mu \rightarrow e$ decay is studied in magnetic fields by detecting the $\pi \rightarrow \mu \rightarrow e$ decays in photoemulsion. It is found that longitudinal magnetic fields from 20 to 30 kgauss do not cancel totally the depolarizing effect of the medium (photoemulsion) on the μ meson. (auth)

21449 APPLICATIONS OF THE SAKATA MODEL FOR ELEMENTARY PARTICLES. Elizabeth Hormann (Univ. of Manchester, Eng.). Nuclear Phys., 24: 514-18(1961). (In English)

Simple sub-symmetries of the three-dimensional unitary group are used to describe and classify all interactions, including in particular electromagnetic interactions. All known types of interaction, and only these, appear. Application to the leptons succeeds in forbidding the direct electromagnetic $\mu-e$ decay. A suggestion is made for the removal of the $\mu-e$ mass degeneracy, and the range of applicability of the approach is discussed. (auth)

21450 THE ELECTRIC POLARIZABILITY OF THE NEUTRON IN THE STATIC MESON THEORY. Akira Kanazawa (Purdue Univ., Lafayette, Ind.). Nuclear Phys., 24: 524-6(1961). (In English

The electric polarizability of the neutron is calculated in the framework of the static meson theory. The calculated values of the electric polarizability are $\alpha = 1.1 \times 10^{-42}$ cm^3 for a Gaussian cut-off with cut-off momentum $k_c = 5.6$ times the meson mass, and $\alpha = 1.0 \times 10^{-42}$ cm^3 for an inverse square cutoff with the same cutoff momentum. (auth)

21451 A MODEL FOR S-WAVE $\bar{K}$-$\mathcal{N}$ SCATTERING. B. H. Bransden, H. Rashid, and R. G. Moorhouse (Univ. of Glasgow). Nuovo cimento (10), 20: 213-24(Apr. 16, 1961). (In English)

The importance of pair creation in the scattering of K mesons by nucleons is investigated by means of a specific model. A model Hamiltonian is employed that allows only the elementary virtual processes $\pi \rightleftharpoons N + \bar{N}$ and $\bar{K} \rightleftharpoons Y + \bar{N}$ where Y stands for a hyperon, and N for a nucleon. Three coupled integral equations are obtained for the scattering amplitudes, which represent an exact solution to the model problem. These equations are solved numerically and the characteristics of the model are discussed. (auth)

21452 THE DETERMINATION OF THE SIGN OF THE ASYMMETRY PARAMETER IN λ^0 DECAY FROM THE SCATTERING OF THE DECAY PROTON. T. Bowen, C. R. Sun, and A. E. Werbrouck (Princeton Univ., N. J.). Nuovo cimento (10), 20: 225-36(Apr. 16, 1961). (In English)

A statistical method is presented which the information provided by a small number of nuclear scatters of protons from Λ^0 decay can be used to determine the sign of the asymmetry parameter caused by parity non-conservation in Λ^0 decay. As an example, the analysis is applied to the scattering of twenty one protons that are produced in Λ^0 decay, in a cloud chamber. Because the asymmetry to be expected in each observed nuclear scatter is small, the data do not yield a statistically significant result. However, observation of a large number of events should make possible a determination of the sign with a high degree of certainty. (auth)

21453 DOUBLE DISPERSION RELATIONS FOR DEUTERON PHOTO- AND ELECTRODISINTEGRATION. A. Martin and R. Vinh Mau (CERN, Geneva). Nuovo cimento (10), 20: 246-64(Apr. 16, 1961). (In English)

The deuteron photodisintegration matrix element, which exhibits anomalous thresholds in the relativistic case, is studied in the nonrelativistic case, where the nucleons interact through a superposition of Yukawa or exponential potentials. For simplicity all spins are taken to be zero. A double dispersion relation is derived. The treatment is extended to electrodisintegration. (auth)

21454 TRANSVERSE MOMENTUM OF PARTICLES EMITTED IN 4.2 GeV PROTON-PROTON COLLISIONS. M. H. Blue, J. J. Lord, J. G. Parks, and C. H. Tsao (Univ. of Washington, Seattle). Nuovo cimento (10), 20: 274-9 (Apr. 16, 1961). (In English)

The transverse momentum spectra of pions and protons produced in inelastic 4.2 Bev proton-proton collisions are presented. Shapes of the observed momentum spectra seem to be independent of the number of particles produced in an interaction; however, the observed proton momenta tend toward higher values (by about a factor of 2) than the observed pion momenta. A transverse momentum spectrum for elastically scattered protons is compared to the proton spectrum from inelastic events. Agreement is obtained above 300 Mev/c. Values of the proton transverse momentum less than about 100 Mev/c are much more probable for elastically scattered protons, while values around 150 Mev/c appear more probable for inelastically scattered protons. (auth)

21455 ON THE OBSERVABILITY OF THE SIGNS OF THE STRONG INTERACTION COUPLING CONSTANTS. D. B. Lichtenberg (Michigan State Univ., East Lansing). Nuovo cimento (10), 20: 324-33(Apr. 16, 1961). (In English)

Criteria are given for the observability of the signs of coupling constants appearing in elementary particle interactions. The results are applied to various strong interaction Lagrangians. For a certain meson-baryon interaction with eight coupling constants, it is shown that only four (independent) relative signs are observable. The signs of the coupling constants in certain meson-meson interactions are discussed briefly. Some difficulties in measuring the observable signs are mentioned. (auth)

1456 RESONANCE POLES AND THE REACTION ATRIX. R. Oehme (Univ. of Chicago). Nuovo cimento 0), 20: 334-43(Apr. 16, 1961). (In English)
Within the framework of relativistic dispersion theory, e reaction K-matrix is considered as an analytic matrix- nction. For the case of two coupled two-particle channels, is shown that the elements of this matrix are regular nctions except for cuts due to dynamical branch lines of e amplitudes and possible isolated poles. Expressing the action amplitudes in terms of the elements of the K atrix makes it possible to exhibit the Riemann surface these amplitudes. The connection between resonance and les of the amplitudes in secondary Riemann sheets is dis- ssed with the help of the K matrix formalism. The pos- ble connection between a resonance and a bound state is nsidered. (auth)

1457 PROPOSAL OF AN EXPERIMENT ON $\Sigma^{\pm}$- ECAYS. Ph. Meyer, J. Prentki, and Y. Yamaguchi ERN, Geneva). Nuovo cimento (10), 20: 344-50(Apr. 16, 61). (In English)
A discussion is given of specific experimental conditions der which the s or p wave nature of the decays $\Sigma^{\pm} \rightarrow n +$ can be determined through a study of the neutron polari- tion. Besides being a check of the $|\Delta I| = \frac{1}{2}$ rule this ex- riment gives a measure of the Σ^{+} polarizations and erefore leads to the determination of the magnitude and gn of the asymmetry coefficient α^{0}. (auth)

1458 THE DECAY OF NEGATIVE π-MESONS TOPPED IN LIGHT ELEMENTS AND INSULATORS. Culligan, D. Harting, N. H. Lipman, L. Madansky, and Tibell (CERN, Geneva). Nuovo cimento (10), 20: 351- Apr. 16, 1961). (In English)
Beams of 170 Mev/c π^{+} or π^{-} mesons, from which the π esons are selected, by time-of-flight methods, are opped in Be, B_4C, Teflon, and Al targets. The ratio of e numbers of electrons produced by the negative and sitive beams by π-μ-e decay is determined for each of ese materials. Assuming that no π^{-} decay occurs in the target, an upper limit of one per cent is found for the cay probability of π^{-} mesons stopped in either Be, B_4C, Teflon. (auth)

1459 INVESTIGATION OF THE POSSIBILITY OF A -λ RESONANCE IN THE CASE OF DIFFERENT PARITIES F λ AND Σ. F. Duimio and G. Wolters (CERN, Geneva). uovo cimento (10), 20: 259-65(Apr. 16, 1961). (In Eng- sh)
In view of experimental information concerning energy d total angular momentum of the π-Λ resonant state, an alysis is made of pion-hyperon scattering based on the ssumption of different parities of Λ and Σ. Since the sonance occurs in the low energy region, a fixed source eld theoretic model is used. This model leads to an ac- urate description of π-N low energy scattering. It is found at the present data are in better agreement with the basic ssumptions than with global symmetric assumptions. (auth)

1460 A MODEL FOR DOUBLE PHOTOPRODUCTION F CHARGED PIONS. [PART] II. D. Boccaletti, G. De ranceschi, and C. Gauldi (Scuola di Perfezionamento in isica Nucleare, Rome). Nuovo cimento (10), 20: 375-89 Apr. 16, 1961). (In English)
Using the matrix element for double photoproduction of harged pions by γ-p interactions, the π^{-} energy spectrum t three fixed angles and the π^{-} angular distribution at three xed energies are calculated. The $^3/_2$ $^3/_2$ final state π^{+}-p in- eraction is also taken into account. The resulting correc- on changes the form of the π^{-} spectrum very little. The aim of the calculation is to determine the possibility of separating experimentally the predictions made by the present diagram and the Drell diagrams, the interference term of the two graphs being zero. A γ energy of 900 Mev is taken. (auth)

21461 EFFECTS OF THE γ-3π INTERACTION ON PHOTOREACTIONS. M. Kawaguchi (Tokyo Univ. of Education), Y. Miyamoto, and Y. Fujii. Nuovo cimento (10), 20: 408-12(Apr. 16, 1961). (In English)
The effects of the γ-3π reaction on photoreactions are studied. A π-π resonance in the I = J = 1 state is assumed. Diagrams for the reactions $\gamma + N \rightarrow \pi + N$, $\gamma + N \rightarrow 2\pi + N$, and $\gamma + d \rightarrow n + p$ are shown, including the γ-3π effects. The first of these diagrams yields the coupling constant of the I = J = 1 resonance. The last of the diagrams gives information as to the properties of the E1 and M1 moments of the deuteron. (T.F.H.)

21462 THE NUCLEON CORE IN HIGH-ENERGY NEUTRINO PROCESSES. N. Cabibbo (C. N. E. N., Frascati, Italy and Università, Rome). Nuovo cimento (10), 20: 413-15(Apr. 16, 1961). (In English)
The effects of the electromagnetic nucleon form factors on the cross sections of the reactions $\bar{\nu} + p \rightarrow n + e^{+}$ and $\nu + n \rightarrow p + e^{-}$ are investigated. It is assumed that the proton magnetic form factor falls off more rapidly than $(1 + k^2/a^2)^{-2}$, where k^2 is the momentum transfer and a is the incident ν energy. The proton charge form factor is assumed to have a plateau at ~0.42. The total cross sections at various ν energies and the differential $e^{\pm}$ production cross sections at fixed energy are calculated. The cross sections calculated using exponential form factors are compared with those using the proton form factors described above. (T.F.H.)

21463 AZIMUTHAL SYMMETRY IN 27 GeV JETS. C. Castagnoli (Università, Parma, Italy), C. Lamborizio, I. Ortalli, and A. Barbaro-Galtieri. Nuovo cimento (10), 20: 416-18(Apr. 16, 1961). (In English)
An experiment is described whose purpose is to detect azimuthal asymmetry in jets that are caused by p-nucleus reactions at 27 Bev. A statistical method is given for combining all jets with a given number of prongs n_s. The angular distributions of 142 jets are determined in emulsion. The jets are found to be azimuthally symmetric for both high and low n_s. (T.F.H.)

21464 VECTOR FIELD ASSOCIATED WITH THE UNITARY THEORY OF THE SAKATA MODEL. A. Salam (Imperial Coll. of Science and Tech., London) and J. C. Ward. Nuovo cimento (10), 20: 419-21(Apr. 16, 1961). (In English)
For the Sakata elementary particles (p,n,Λ), a traceless Hermitian 3 × 3 matrix is found from which the existence of eight vector mesons may be inferred. These mesons include four that resemble K mesons, three that resemble π mesons, and an isoscalar ρ^{0} particle. It is shown that psuedo-vector mesons may be produced by gauge transformations on the Hermitian matrix. Similarly, a set of 3 × 3 matrices is found that affords an approximation to a gauge theory for weak vector bosons. (T.F.H.)

21465 INVALIDITY OF THE RAPHAEL ANALYSIS FOR MODERATE ENERGY NN SCATTERING. Peter Signell and Richard Yoder (Pennsylvania State Univ., University Park.). Phys. Rev., 122: 1897(June 15, 1961).
The Raphael modified effective-range expansion for nucleon-nucleon scattering is usually truncated at the second term. It is explicitly shown that the resulting series is not a good representation of the predictions of reason-

able potential models for moderate energy nucleon-nucleon scattering. In particular, the series can lead to the wrong sign for the shape parameter. (auth)

21466 RADIATIVE CORRECTIONS TO ELECTRON-PROTON SCATTERING. Yung-Su Tsai (Stanford Univ., Calif.). Phys. Rev., 122: 1898-1907(June 15, 1961).

The radiative corrections to the electron-proton scattering are calculated with the effects of the proton recoil taken into account. Only the final electrons are momentum-analyzed. The anisotropy in the maximum energy of photons which can be emitted and the radiation from the proton current are the two main effects due to the proton recoil, and both effects are considered. The mesonic effects in the two-photon exchange diagrams are not considered. Neglecting the uncertainty in the mesonic effects, the formula is valid up to about 5 Bev. (auth)

21467 INVESTIGATION OF BREMSSTRAHLUNG AND PAIR PRODUCTION AT ENERGIES $>10^{11}$ ev. E. Lohrmann (Univ. of Chicago). Phys. Rev., 122: 1908-16(June 15, 1961).

Pair production and bremsstrahlung at energies >100 Bev is investigated in nuclear emulsions by studying 91 primary electron-positron pairs starting high-energy cascades, along with the first secondary pair. The average energy of the showers is 320 Bev. The experimental results on the total number and the energy spectrum of photons radiated by electrons $\gtrsim 100$ Bev show a lack of soft photons, in disagreement with the Bethe-Heitler theory. The experiment agrees with the theory given by Landau, Pomeranchuk, Migdal, and Ter-Mikaeljan. A method for obtaining the mean free path L for direct pair production is presented that avoids the use of a correction for spurious tridents. A value $L = 12_{-4}^{+7}$ cm is obtained for an average electron energy of about 160 Bev. The conversion length of photons of average energy 320 Bev in nuclear emulsion is 34 ± 5 mm, in agreement with the theoretical value of 37 mm. The distribution of the separation between the electron and the positron of the original high-energy pair is also in agreement with the theoretical distributions. This indicates that no appreciable discrepancy can exist between experiment and the theoretical cross section for the energy partition between an electron and a positron, and the probability of large energy losses by radiation. Several high-energy showers presumably produced by μ mesons and one possible case of a double pair production are described. (auth)

21468 PRODUCTION OF PION PAIRS—ISOSPIN ANALYSIS. P. Carruthers (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 122: 1949-53(June 15, 1961).

The reactions $\gamma + N \rightarrow 2\pi + N$ and $\pi + N \rightarrow 2\pi + N$ are analyzed in terms of the relevant isospin amplitudes. An experiment is suggested to measure the phase difference between even and odd π–π isospin states, with a view toward detecting a resonance in the π–π system. The experimental determination of the magnitude and phase of the amplitudes for the second reaction is discussed. (auth)

21469 SOME CONSIDERATIONS ON GLOBAL SYMMETRY. T. D. Lee and C. N. Yang (Institute for Advanced Study, Princeton, N. J.). Phys. Rev., 122: 1954-61(June 15, 1961).

If the Λ-π resonance (Y* state) is related to the $T = 3/2$, $J = 3/2$ resonance in πp scattering, global symmetry considerations should become relevant. Global symmetry is discussed with a view to understanding its group structure. The possibility is also discussed of reconciling the conflict between experimental results and global symmetry. The partial widths of the Y* state are calculated and also those of the companion excited states Z* and Ξ*. A generalization of the quantum number G is discussed. (auth)

21470 ELASTIC SCATTERING OF MUONS IN NUCLEAR EMULSION. P. L. Connolly, J. G. McEwen, and J. Orear (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 6: 554-6(May 15, 1961).

Mesons μ^+ and μ^-, at maximum energies of 43 and 60 Mev respectively, are elastically scattered by emulsion nuclei. For the μ^+ scattering, only 14 to 40 Mev muons that are scattered between 80 and 180° are considered. The calculated and observed number of μ^+ events having a momentum transfer greater than q, and the average differential scattering cross sections for Ag and Br, are given as functions of q. Only preliminary results are given for μ^- scattering. No indication of an anomalous μ-nucleus interaction is found. (T.F.H.)

21471 PROPOSED METHOD OF MEASURING THE SPIN OF THE K′ MESON. M. Schwartz (Columbia Univ., New York). Phys. Rev. Letters, 6: 556-7(May 15, 1961).

A method for determining the spin of the π-K resonance at 880 Mev (K′ meson) is proposed, in which the reactions $p + \bar{p} \rightarrow K^0 + \bar{K}^{0\prime}$ or $p + \bar{p} \rightarrow K^{0\prime} + \bar{K}^0$ are studied. It is assumed that these reactions proceed from an S-state. It is shown that if the K′ spin is 1, the emergent K mesons may decay by either the K_1^0 or K_2^0 modes; if, however, the spin is 0, both of the emergent K mesons must decay by the same decay mode. Hence, if two K_1^0 or two K_2^0 decays are always observed in coincidence, the K′ spin is 0. If these decays are not always in coincidence, the K′ spin is 1. (T.F.H.)

21472 PION-LAMBDA RESONANCE (Y_1*). J. P. Berge, P. Bastien, O. Dahl, M. Ferro-Luzzi, J. Kirz, D. H. Miller, J. J. Murray, A. H. Rosenfeld, R. D. Tripp, and M. B. Watson (Univ. of Calif., Berkeley). Phys. Rev. Letters, 6: 557-62(May 15, 1961).

The π-Λ resonance (Y_1*) is studied in the sequence of reactions $K^- + p \rightarrow Y_1^{*\pm} + \pi^{\mp}$, followed by $Y_1^{*\pm} \rightarrow \Lambda + \pi^{\pm} + 130$ Mev. The K^- momentum is varied from Y_1* threshold at 405 Mev/c to 850 Mev/c. The mass of Y_1* is determined to be 1385 Mev, with a half width near 20 Mev. It cannot be determined whether the Y_1* spin is $(J)1/2$ or $3/2$. (T.F.H.)

21473 BOSE STATISTICS AND Y* PRODUCTION AND DECAY IN K^--p COLLISIONS. R. H. Dalitz and Donald H. Miller (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 562-7(May 15, 1961).

The reaction sequence $K^- + p \rightarrow Y^{*\pm} + \pi^{\mp} \rightarrow \Lambda + \pi^+ + \pi^-$ is considered. Difficulties encountered in measuring the Y* mass, half width, spin, and parity are explained, on the assumption that the Y* does not decay as a free particle. It is shown that the Y* decay phenomena can be explained as resulting from the Bose statistical requirements for the two final state pions. (T.F.H.)

21474 PION-NUCLEON INTERACTIONS IN THE REGION OF THE HIGHER RESONANCES. P. Carruthers (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 6: 567-70(May 15, 1961).

Reactions $\pi^{\pm} + p \rightarrow \pi^{\pm} + \pi_3 + N$ near a Bev are studied. Resonances in the reactions $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ and $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ are examined. It is noted that the data for the second of these reactions cannot be explained either by a one-pion exchange process, or by a process in which the two final-state pions collide, causing one of the pions to be rescattered by the proton. The π^--p results are applied to the reaction $\pi^+ + p \rightarrow \pi^+ + \pi^0 + p$ at 800 Mev. (T.F.H.)

21475 I-SPACE PARITY CONNECTION IN NONLEPTONIC WEAK INTERACTIONS. W. B. Zeleny (Univ. of Sidney). Phys. Rev. Letters, 6: 570-1(May 15, 1961).

A doublet approximation for both strong and weak nonleptonic interactions is described. This approximation leads to a connection between I space and parity ($\vec{I}$ = doublet spin). A basis for this connection is established, assuming for weak interactions, the existence of a scalar and isoscalar ω^0 meson of mass about 310 Mev. Arguments for and against the existence of the ω^0 are presented. The implications of the model used in this analysis are outlined. (T.F.H.)

21476 ANGULAR DISTRIBUTION OF ELECTRONS SUFFERING CHARACTERISTIC ENERGY LOSS IN PASSAGE THROUGH METAL FILMS. Hiroshi Watanabe (Hitachi Central Research Lab. Kokubunji, Tokyo). J. Phys. Soc. Japan, 16: 912-16(May 1961).

The distribution in energy and angle of 20 to 25 kv electrons scattered by Al, Ag, and Au evaporated films was measured with an electron velocity analyser of Möllenstedt type. The energy resolution is about 5×10^{-5}, and the angular resolution better than 5×10^{-4} radian. The angular distribution of the characteristic energy loss was compared with Ferrell's calculation. The comparison shows that the experimental result is consistent with a simple Bohm-Pines' approach provided that a correction is made for finite resolution of both energy and angle. (auth)

21477 THE GENERALIZED TRANSPORT EQUATION FOR AN ELECTRON. A Solution in a Simple Case. L. Van Hove and E. Verboven (Rijksuniversiteit, Utrecht). Physica, 27: 418-32(Apr. 1961). (In English)

The master equation to general order in the coupling responsible for the dissipative behavior, derived earlier, is applied to the simple case of an electron in a system of randomly distributed, static, elastic scatterers. Replacing $W_{11'}(k,k')$ by a constant, the equation can be solved approximately for general strength of the coupling. The solution, describing the approach to equilibrium of the electron momentum distribution, has an oscillatory character. The slightly more complicated case of an electron interacting with a vibrating harmonic lattice is also considered. It is shown how one can derive from the generalized master equation an equation describing the evolution of the electron alone, the phonons only entering through their coarse grained distribution in wave vector. Neglecting the phonon energies, one finds an equation of the same form as in the case of static, elastic scatterers. (auth)

21478 THE λ^0-NUCLEON INTERACTION IN LIGHT HYPERNUCLEI. P. B. Jones (Oxford Univ.). Proc. Roy. Soc. (London), A, 261: 443-56(May 23, 1961).

The binding energies of the hypernuclei H^3_Λ, H^4_Λ, and He^5_Λ are investigated by a method that includes the effect of a possible hard core in the Λ^0-nucleon potential. It is found that a central (non-exchange) spin-dependent potential with a hard core of variable radius leads to the observed Λ^0 binding energies. It is shown that the existence of the hyperdeuteron (H^2_Λ) is unlikely. (auth)

21479 ISOSPIN AND PARITY IN NON-LINEAR SPINOR THEORY. H.-P. Dürr (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 327-45(Apr. 1961). (In German)

The isospin transformation properties and the space reflection symmetry in a nonlinear field theory of elementary particles, as proposed by Heisenberg and coworkers, are studied. In section I it is shown that the nonlinear equation $\gamma_\mu (\partial/\partial x_\mu)\, \psi \pm l^2 \gamma_5 \gamma_\mu\, \psi(\bar{\psi}\gamma_5\gamma_\mu\psi) = 0$ for a 4-component spinor operator ψ is equivalent to the equation $-i\sigma_\nu(\partial/\partial x_\nu)\, \chi \pm l^2\, \sigma^\mu \chi(\chi^* \sigma_\mu \chi) = 0$ for a 4-component Weyl-isospinor operator χ. In this Weyl representation of the theory the Pauli-Gürsey transformations and the Touschek transformation can be replaced by the conventional forms of the isospin rotations and the gauge transformation of the first kind, respectively. In section II an attempt is made to introduce parity in a rigorous manner using the invariance of the equation under l-Inversion $l \to -l$. Some important aspects of symmetry operations which involve transformations of parameters are discussed. By virtue of the parity symmetry a Dirac notation may be introduced, and the nonlinear equation then corresponds to a Touschek invariant equation of the Dirac type with nonlinear vector- and axial-vector terms of equal strength. The existence of particles with finite mass suggests a degeneracy of the ground state "world" with respect to parity. In section III and IV the Tamm-Dancoff method is applied for an estimate of the masses of nucleons and bosons with spin and isospin zero or one, using the simpler Weyl representation with and without consideration of the parity symmetry, respectively. (auth)

21480 THE SCATTERING OF DEUTERONS ON DEUTERONS WITH CONSIDERATION OF THEIR MUTUAL DISTORTION. G. Ernst and S. Flügge (Institut für Struktur der Materie, Marburg, Ger.). Z. Physik, 162: 448-67(1961). (In German)

The elastic scattering of deuterons in deuterium has so far only been treated in Born approximation, at rather high energies. Integro-differential equations are derived to deal with the scattering phenomenon at energies of a few Mev. The mutual distortion of the two deuterons at close distances turns out to have a large influence on the angular distribution. A simple and plausible assumption was made concerning this distortion, and the results were compared with experiment for two energies. (auth)

21481 THE WEAK INTERACTIONS. S. B. Treiman (Princeton Univ., N. J.). p.515-98 of "Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

The weak interactions of elementary particles are discussed using a "kinematic" approach. The strangeness classification scheme which provides rules for distinguishing between strong and weak processes is reviewed. The symmetry principles of space inversion, time reversal, and charge conjugation are outlined. Weak reactions were classified according to whether they do or do not involve leptons. The two-component theory of the neutrino and the c-number Dirac theory as applied to neutrinos are reviewed. Meson (μ) decay, lepton conservation, characterization of $\Delta S = 0$ leptonic couplings, beta decay, conserved vector current theory, electron and meson (μ) universality, and meson (μ) capture are discussed. All evidence obtained for meson (μ) decay and leptonic $\Delta S = 0$ processes is shown to be consistent with the two-component theory of the neutrino, time reversal invariance, lepton conservation, universality between electrons and mesons (μ) in their weak couplings, V, A structure of the couplings, and lack of renormalization of the β decay vector coupling constant. The $\Delta S \neq 0$ leptonic processes are also described. The problem of meson (K^0) decay is reviewed. Non-leptonic weak reactions are discussed. Several universal models for weak interactions are proposed and described. (M.C.G.)

21482 STRONG INTERACTIONS OF STRANGE PARTICLES. Y. Yamaguchi (Osaka City Univ.). p.599-671 of

"Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

Strong interactions of strange particles based on the Gell-Mann-Nishijima scheme are discussed. The scheme, several versions of formulating strong interactions, and their experimental implications are described. Isospin, strangeness, charge independence, formulation of strong interactions, elementary consequences of high symmetry hypothesis, violation of charge independence and electromagnetic interactions, determination of spin, parity of particles, parity determination, the neutral K-complex, the Stark effect in (K^- p) atoms, the effective range theory of K-N and K-N scattering, K-N scattering with $m_K \neq m_{K^0}$, pololog, determination of relative parity and coupling constants, and application of forward K-N dispersion relations are discussed. (M.C.G.)

21483 INTRODUCTION TO ELEMENTARY PARTICLE PHYSICS. R. E. Marshak and E. C. G. Sudarshan. Interscience Tracts on Physics and Astronomy. 11. New York, Interscience Publishers, Inc., 1961. 238p. $2.50(paper), $4.50(cloth).

The physics of elementary particles is reviewed. Quantum mechanical formalisms in elementary particle physics are outlined, including relativistic wavefunctions and wave equations, particle-quantized field interactions, and second quantization. Discrete transformations are studied. Selection rules such as space and time inversion; particle conjugation; CP, CPT, and chirality invariance; and parity are discussed. Additive conservation laws and various gauge properties are examined. Isospin properties in all types of interactions are studied. An elementary field theory is developed. (T.F.H.)

Neutron Physics

21484 (AFCRL-TR-60-355) ABSORPTION ANALYSIS APPLIED TO NEUTRONS IN A THERMAL COLUMN. L. F. Lowe and E. A. Burke (Air Force Cambridge Research [Center]. Electronic Material Sciences Lab., Bedford, Mass.). Nov. 1960. 19p. (AD-251549)

The energy spectrum of diffuse neutrons in the thermal column of the MIT reactor was determined by analyzing transmission data. The results were compared to a Maxwellian distribution and to a previous experiment done on collimated thermal neutrons. (auth)

21485 (APDA-141) HAFEVER—AN INELASTIC SCATTERING CODE FOR THE IBM 704 COMPUTER. M. A. Friedman and P. F. Zweifel (Atomic Power Development Associates, Inc., Detroit). Sept. 1960. 28p.

A description is given of HAFEVER, an IBM 704 code for calculating the energy-exchange inelastic-scattering cross-section according to the Hauser-Feshbach theory as modified by Goldman. The code calculates only the cross section integrated over the angle. (B.O.G.)

21486 (GAMD-1969) THE EGELSTAFF-SCHOFIELD APPROACH TO THERMAL NEUTRON SCATTERING LAW DATA. Mark S. Nelkin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 25, 1961. Contract AT-(04-3)-167. 10p.

Outlines are given of the ideas of Egelstaff and Schofield concerning the interpretation of thermal-neutron scattering-law data, and a program of data analysis and numerical reconstruction of the scattering law. (B.O.G.)

21487 MULTIGROUP DIFFUSION EQUATIONS WITH ARBITRARY SPACE DEPENDENT COEFFICIENTS. C. A. Stevens and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Trans. Am. Nuclear Soc., 4: No. 1, 75(June 1961).

21488 NIOBE—AN IBM 7090/704 CODE FOR THE NUMERICAL INTEGRATION OF THE BOLTZMANN TRANSPORT EQUATION. S. Prieser and G. Rabinowitz (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 75-6(June 1961).

21489 THE TWO DIMENSIONAL, QUADRUPLE P-0 AND P-1 APPROXIMATION. R. C. Gast (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 76-7(June 1961).

21490 CONVERGENCE OF TRANSPORT SOLUTIONS FOR THIN SLAB CELLS. D. Meneghetti (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 77(June 1961).

21491 MULTICHANNEL FLUX SYNTHESIS. E. L. Wachspress (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 77-8(June 1961).

21492 CLAG, A PROGRAM FOR THE PHILCO-2000 TO SOLVE THE REACTOR DIFFUSION EQUATION USING COUPLED LINES AND GROUPS. R. D. Burgess and S. Baron (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 78-9(June 1961).

21493 THE SPM EQUATION FOR CALCULATING SPATIAL VARIATION OF NEUTRON SPECTRA. C. N. Klahr (Technical Research Group, Inc., Syosset, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 82-3(June 1961).

21494 THE PENETRATION AND SLOWING DOWN OF FAST NEUTRONS IN BERYLLIUM AND BERYLLIUM OXIDE. H. Goldstein and A. D. Kurmbein (Nuclear Development Corp., of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 131-2(June 1961).

21495 REFINED ANALYSES OF SLOWING DOWN PROBLEMS IN WATER. H. Amster and R. Gast (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 132(June 1961).

21496 ANISOTROPY OF NEUTRON SPECTRUM IN A LATTICE SYSTEM. H. Takahashi (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 132-3(June 1961).

21497 TIME DEPENDENT NEUTRON THERMALIZATION. J. Koppel (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 133-4(June 1961).

21498 THE SCATTERING OF THERMAL NEUTRONS BY MODERATORS. P. A. Egelstaff (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Am. Nuclear Soc., 4: No. 1, 134-5(June 1961).

21499 A COMPARISON OF CALCULATED AND EXPERIMENTAL THERMAL ENERGY EXCHANGE CROSS SECTIONS. D. T. Goldman and F. E. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 135(June 1961).

21500 NEUTRON SPECTRA IN POISONED GRAPHITE D. E. Parks, G. D. Trimble, R. B. Walton, J. L. Wood, and J. R. Beyster (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 135-6(June 1961).

21501 EXPERIMENTAL EFFECTIVE CROSS SECTIONS AND NEUTRON SPECTRA IN A URANIUM FUEL ROD. B. G. Chidley, C. B. Bigham, and R. B. Turner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Am. Nuclear Soc., 4: No. 1, 136(June 1961).

21502 DIFFUSION PARAMETERS FOR HETEROGENEOUS SYSTEMS. J. H. Ferziger (Stanford Univ., Calif.). G. S. C. Wang, and P. F. Zweifel. Trans. Am. Nuclear Soc., 4: No. 1, 154(June 1961).

21503 THE CALCULATION OF EFFECTIVE CUTOFF ENERGIES FOR CADMIUM AND SAMARIUM. G. D. Hickman and W. B. Leng (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 154-5 (June 1961).

21504 BLACKNESS COEFFICIENTS IN TWO DIMENSIONS. C. W. Maynard (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 155-6 (June 1961).

21505 NEUTRON SELF-SHIELDING IN SLAB ABSORBERS. J. S. Martinez (Univ. of California, Berkeley), T. H. Pigford, and A. J. Kirschbaum. Trans. Am. Nuclear Soc., 4: No. 1, 156-7(June 1961).

21506 DISADVANTAGE FACTORS BY THE P_2 CALCULATION. J. O. Mingle (Kansas State Univ., Manhattan). Trans. Am. Nuclear Soc., 4: No. 1, 157-8(June 1961).

21507 SOLUTION OF THE P-3 EQUATIONS IN FINITE CYLINDRICAL GEOMETRY AND APPLICATION TO THE CALCULATION OF THERMAL UTILIZATION. J. Agresta and N. Tralli (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 158(June 1961).

21508 ANGULAR REDUCTION OF THE SCATTERING INTEGRAL IN THE DOUBLE-P REPRESENTATION OF THE TRANSPORT PROBLEM. B. D. O'Reilly (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 158-9(June 1961).

21509 TWO-GROUP BUCKLING SYNTHESIS. W. J. Levedahl (General Nuclear Engineering Corp., Dunedin, Fla.). Trans. Am. Nuclear Soc., 4: No. 1, 159-60(June 1961).

21510 EIGENVALUES FOR THE WILKINS EQUATION. E. Garelis (General Electric Co., Pleasanton or San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 160-1(June 1961).

21511 NEW SOLUTION FORMS OF THE BOLTZMANN EQUATION FOR MONOENERGETIC NEUTRON TRANSPORT IN SPHERICAL GEOMETRY. W. Kofink (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 162: 489-507(1961). (In German)

The singular solution of the Boltzmann equation for neutron transport in spherical geometry is derived. The calculation is performed in two steps. First, a partial differential equation with an assumed density on its right hand side is solved. But the partial solution found in this way will generally not yield the assumed density. Therefore a suitable solution of the homogeneous differential equation is developed. This addition leads to an equation of compatibility which turns out to be a Sonine integral equation. The second step of the calculation is the solution of this integral equation. The total solution of the Boltzmann equation is in two different representations, but its uniqueness is proved. The main singularity at the center of the sphere is proportional to $1/(\rho\sqrt{1-\mu^2})$. A term $\log \rho$ does not appear, but a term proportional to $\log [(1+\mu)/(1-\mu)]$ does which, however, loses its importance at the center of the sphere $\rho = 0$ in comparison with the main singularity. A characteristic equation need not occur in this mathematical procedure; it may or may not be introduced. Therefore no hint at the spectrum of the Boltzmann operator in spherical geometry is given. It is shown that there exists a remarkably short integral representation of the regular solution which satisfies from the first all requirements, if the validity of the characteristic equation is supposed. But there are also regular solutions, given by the difference of two singular solutions, which need not satisfy a characteristic equation. Both kinds of regular solutions in spherical geometry are given as superpositions of solutions in plane geometry which belong to the discrete or to the continuous spectrum of the Boltzmann operator. The regular solutions are identical with the corresponding well-known series of spherical harmonics, where a characteristic equation is not necessarily supposed for an exact solution in the infinite space. A preliminary discussion is given. (auth)

Nuclear Properties and Reactions

21512 (AFCRL-407) MESON PRODUCTION IN NUCLEUS-NUCLEUS COLLISIONS. Technical Note No. 2. G. Alexander, J. Avidan, A. Avni, and G. Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). Nov. 15, 1960. Contract AF 61(052)-371. 20p.

Nucleus-nucleus collisions at cosmic-ray energies are described by a simple geometrical model. The average multiplicity for different types of reactions is predicted and compared with experimental observation. (auth)

21513 (AFOSR-225) A STUDY OF THE INTERNAL FIELDS ACTING ON IRON NUCLEI IN IRON GARNETS, USING THE RECOIL-FREE ABSORPTION IN Fe^{57} OF THE 14.4 KEV GAMMA RADIATION FROM Fe^{57m}. Technical Note No. 2. R. Bauminger, S. G. Cohen, A. Marinov, and S. Ofer (Hebrew Univ., Jerusalem). Dec. 1960. 25p. (AD-251235)

The shape of the recoil-free absorption spectrum obtained in iron garnet absorbers was investigated with a Co^{57} source embedded in stainless steel. The results confirm the existence of two iron sublattices each showing a Zeeman structure characterized by different parameters. No significant differences were detected between the Zeeman structure in yttrium iron garnet and dysprosium iron garnet. The values obtained for the effective magnetic field at the Fe^{57} nuclei at room temperature are 3.90×10^5 and 4.85×10^5 gauss for the "d" and "a" iron lattice sites, respectively. At liquid air temperature, the corresponding fields are 4.6×10^5 and 5.4×10^5 gauss, respectively. The mean value of the chemical shift for the "d" sites relative to stainless steel is about 0.04 ± 0.005 cm/sec and for the "a" sites about 0.06 ± 0.005 cm/sec. (auth)

21514 (AFOSR-TN-60-91) AN LCAO STUDY OF Be_2. Robert Hampson and J. S. Dooling (Catholic Univ. of America, Washington, D. C.). [1960]. Contract AF18(600)-1537. 28p. (AD-251723)

Orbital calculations were carried out to study the interaction of two Be atoms in both ground and excited states. The calculations were made on two bases, one using 1s and 2s atomic orbitals on each atom as the basic orbital set and the other 1s, 2s, and $2p\sigma$ orbitals as the basic set. The repulsive interaction between two ground state Be atoms is found to be decreased by the $2p\sigma$ orbitals, and the virtual orbitals are found to be very close to self-consistent orbitals. Configuration interaction energies are given. (D.L.C.)

21515 (BNL-666) SIGMA CENTER—NEUTRON CROSS SECTION EVALUATION GROUP, NEUTRON CROSS SECTIONS IN ZIRCONIUM, APRIL 1961. Rudolph Sher (Brookhaven National Lab., Upton, Long Island, N. Y.). May 1961. 12p. (BNL-T-220-40-1)

The best available values of the measured cross sections for Zr are given for the energy ranges of 0.02 to 100 ev, 0.1 to 10 kev, 0.01 to 1 Mev, and 1 to 25 Mev. In the 1 to 25 Mev range, (n,p), (n,α), and (n,2n) cross sections are discussed along with elastic and inelastic scattering cross sections. (D.L.C.)

21516 (CF-61-5-67) THE THICK TARGET YIELD AND EXCITATION FUNCTION FOR THE REACTION $Rh^{103}(pn)Pd^{103}$. Paul V. Harper and Katherine Lathrop (Chicago. Univ. and Argonne Cancer Research Hospital, Chicago), and John L. Need (Oak Ridge National Lab., Tenn.). May 16, 1961. 10p.

Rhodium foils were irradiated with the internal 16.7-Mev and external 22.4-Mev proton beams of the ORNL 86-in. cyclotron and Pd^{103} yields determined. The yields were measured to be 236 and 96.8 mc/ma-hr for 22.4 and 16.7-Mev protons, respectively, low compared with the respective calculated values of 520 and 219 mc/ma-hr. The possible reasons for the low results are discussed. The excitation function of Rh^{103}(p,n) is given. (D.L.C.)

21517 (INSJ-38) A NEW MODEL FOR THE THEORY OF THE HIGH ENERGY NUCLEAR INTERACTION. S. Hasegawa (Tokyo Univ., Inst. for Nuclear Study). Apr. 15, 1961. 22p.

A new model of high-energy interactions is proposed in which explosive production of mesons occurs through emission of a small number of quanta which are subsequently converted into mesons. The model is applied to experimental data on shower particles, e.g., p-$\bar{p}$ annihilation. Prong distribution and translational motion of the quantum are considered. A mechanism for the production of quanta is outlined. (D.L.C.)

21518 (JINR-D-681) ON THE ROLE OF ONE-PION POLE DIAGRAM IN γ-RAYS SCATTERING BY PROTONS. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab of Theoretical Physics). 1961. 17p.

It is shown that under the right choice of signs of the pole γ-n scattering diagram, caused by a neutral point decay, its contribution to the cross section for γ-ray scattering by protons decreases considerably. To obtain information on the π^0 lifetime, it is necessary to improve the experimental accuracy. (auth)

21519 (NP-10251) YADERNYE REAKTSII. (DVE LEKTSIĬ). (Nuclear Reactions. (Two Lectures)). K. A. Ter-Martirosyan (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1960. 30p.

The general concept of resonance and direct nuclear reaction mechanisms are analyzed in the presented lectures. The direct inelastic processes: inelastic scattering of neutrons, protons, and α particles on spherical and nonspherical nuclei; the (d,p) and (d,n) reactions; and the photoeffect and particle capture with γ emission (due to direct interactions) are discussed. (R.V.J.)

21520 (NP-10252) OPTICHESKAYA MODEL' YADRA V SVETE SOVREMENNYKH DANNYKH. (Available Data on the Optical Model of Nucleus). I. S. Shapiro (Akademiya Nauk, S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1960. 63p.

Data on the nuclear optical model are reviewed. The properties of the optical model for scattering of neutrons, complex particles, deuterons, and heavy ions are analyzed as well as the optical model and direct processes. (R.V.J.)

21521 (OOR-2945;2) CORE RECONSTRUCTION IN HEAVY DEFORMED NUCLEI. Interim Technical Report 2. Raymond K. Sheline (Florida State Univ., Tallahassee). May 1, 1961. 9p.

It has generally been assumed that in those regions of the nuclear periodic table where there is a considerable prolate deformation, a smooth systematics of rotational and vibrational characteristics would be obtained as protons and neutrons are added. Recently considerable evidence has been collecting to show that the smooth trends in these systematics are not always obtained. These deviations in the systematics are described and classified according to their position in the nuclear periodic table, and a tentative explanation is presented involving structural changes expected on the basis of the Nilsson level systematics. (auth)

21522 (OOR-2945:3) EXPERIMENTAL NUCLEAR ENERGY LEVELS OF Mg^{25} AND THEIR INTERPRETATION. Interim Technical Report 3. Raymond K. Sheline and R. A. Harlan (Florida State Univ., Tallahassee). May 1, 1961. 53p.

Using the reaction $Al^{27}(d,\alpha)Mg^{25}$ and a magnetic spectrograph, 66 levels in Mg^{25} were determined below 8.7 Mev excitation. An interpretation of the levels utilizing the Bohr-Mottelson collective model and an empirical rule was attempted. Results indicated that below 4.8 Mev, agreement with the model is good, while above this energy, deviations from experimental level density and energies can be qualitatively explained by additional intrinsic and vibrational states, Coriolis coupling, and the uncoupling of paired nucleons in higher-spin rotational states. A statistical treatment, used in determining the nuclear temperature of Mg^{25} as $\approx$2.45 Mev, indicated that the level spacing begins to become smaller than experimental energy resolution above 7.7 Mev. (auth)

21523 (PAN-195/OFJ) (d,α) REACTIONS ON SOME LIGHT NUCLEI AT 13 MeV. M. Cindro, M. Cerineo, and A. Strzałkowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1960. 17p.

Angular distributions of alpha particles from the reactions $B^{10}(d,\alpha)Be^8$, $B^{10}(d,\alpha)Be^{8*}$, $F^{19}(d,\alpha)O^{17}$, and $F^{19}(d,\alpha)O^{17*}$ are studied with 13 Mev deuterons, by means of a thin scintillator technique. The results for B^{10} and F^{19} show a forward peaked distribution. An attempted fit in terms of the Butler theory indicates a predominancy of direct processes in the mechanism of these reactions. The angular distribution for the reaction $Al^{27}(d,\alpha)Mg^{25}$ is also measured, but it is not possible to separate the alpha particles corresponding to the ground and the low lying excited states of Mg^{25}. The absolute value of the differential cross section is also measured in all cases. (auth)

21524 (PAN-200/VII) ON THE PROBLEM OF CHARGE DISTRIBUTION AMONG PRODUCTS OF AN INTERNUCLEAR CASCADE. A. Krzywicki and J. Szymański (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 13p.

Proton or pion beams interact with heavy nuclei in emulsion at around 9 Bev, and internuclear cascades ensue. The distributions of the signs of the charged particles in the cascades are studied. An approximate mathematical formulation of the problem is presented. It is shown that for a wide range of conditions the positive charge excess is due to protons. (T.F.H.)

21525 (PAN-203/VI) SOME EXAMPLES OF INTERACTIONS OF VERY HIGH ENERGY PROTONS WITH HEAVY NUCLEI OF PHOTOGRAPHIC EMULSIONS. J. Bartke, Z. Czachowska, R. Hołyński, and K. Rybicki (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 15p.

Three high energy jets ($E_{prim} > 10^{12}$ ev) produced in col-

lisions with nuclei of photographic emulsion are described. In spite of the fact that they are probably produced in central collisions of nucleons with heavy nuclei they show double maximum angular distributions in contradiction with the hydrodynamical model. (auth)

21526 (TID-12834) CONFIGURATION MIXING AND THE EFFECTS OF DISTRIBUTED NUCLEAR MAGNETIZATION ON HFS IN ODD A NUCLEI. H. H. Stroke and R. J. Blin-Stoyle (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science and Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics), and V. Jaccarino (Bell Telephone Labs., Inc., Murray Hill, N. J.). [1960]. Contract AT(30-1)-2098. 79p.

The theory of Blin-Stoyle and of Arima and Horie, in which the deviations of the nuclear magnetic moments from the SPM Schmidt limits are accounted for by configuration mixing, is used to calculate the effects of the distribution of nuclear magnetization (Bohr-Weisskopf effect) on hyperfine structure. The required electron wave functions were calculated for a Hofstader-type charge distribution. Comparison with experiment, where possible, gives satisfactory agreement. The possibility of using such hyperfine structure data in a semi-phenomenological treatment to obtain information on nuclear configurations is discussed. (auth)

21527 (TID-12954) A COMPARISON OF CALCULATED AND EXPERIMENTAL THERMAL ENERGY OF EXCHANGE CROSS SECTIONS. D. T. Goldman and F. D. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. 16p.

Various attempts to calculate the thermal scattering kernel for the moderation of neutrons are discussed. First the scattering cross section from water was calculated and the results compared with available experimental data. The model used was that of Nelkin in which the scattering from the liquid water is considered to be that from an ensemble of harmonic oscillators whose characteristics are due to the nature of the chemical bond. As an additional check on this model, the calculated transport cross section was compared with that given by the "Radkowsky prescription" which uses an effective-mass heavy gas model to predict the transport cross section. The Nelkin model was extended to evaluate the scattering cross section for polyethylene. The cross section was determined by taking the appropriate Fourier transform of the intermediate scattering function, by treating only one of the x-functions exactly, and taking the high energy limit for phonon excitation. Results of the calculations are compared in graph form with experimental results. (M.C.G.)

21528 (UCRL-9619) ANGULAR DISTRIBUTIONS FROM HEAVY-ION-INDUCED FISSION (thesis). Victor E. Viola, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 24, 1961. Contract W-7405-eng-48. 91p.

Angular distributions of fission fragments from heavy-ion-induced nuclear reactions were studied. Targets of $_{79}Au^{197}$ and $_{83}Bi^{209}$ were bombarded with $_{6}C^{12}$, $_{7}N^{14}$, and $_{8}O^{16}$ ions at energies of ~5.5 to 10.4 Mev per nucleon. Both targets were also studied with $_{5}B^{11}$ at the maximum energy. It was observed that the ratio of 0 to 90 deg differential cross sections is much larger for heavy ions than for lighter projectiles. For a given heavy ion, this anisotropy was found to increase with bombarding energy and decrease with the value of Z^2/A of the compound nucleus. There was no distinct evidence for a monotonic relationship between the anisotropy and the mass of the projectile. In this respect, nitrogen was characterized by somewhat lower anisotropies than the other ions. The data were interpreted within the theoretical framework proposed by Halpern and Strutinski and by Griffin to explain fission-fragment angular distributions at moderate energies. In general, these results can be described in terms of the large angular momenta and excitation energies associated with heavy-ion reactions. It is suggested that, on the average, the number of neutrons that are evaporated before fission increases as the atomic number of the compound nucleus decreases. (auth)

21529 THE REDUCED WIDTHS BY VIRTUE OF THE NILSSON MODEL IN THE CASE OF DEUTERON EMISSION. I. Brandus, M. Micu, and A. Sandulescu (Institutul de Fisică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 837-44(1960). (In Rumanian)

The initial and final nuclear states are described by means of the collective model in the strong coupling scheme, and the reduced widths in the case of deuteron emission by a nucleus in the compound system state are calculated. In the hypothesis where the two nuclei undergo the same deformation and from the Pauli principle, the values of the reduced widths are discussed as a function of the nature of the state of the particles forming the system. Thus, for example, the reduced width is zero if the states of the individual nucleons, found both in the initial and the final nucleus, are not the same in the two nuclei. When these states are identical, the reduced width is expressed by the integrals of the wave functions of the nucleons emitted. In this case, the wave functions of the particles are written so that the matrices of the operators $\underline{j}^2$ ($\underline{j}$ being the total kinetic moment of particle) and $\underline{j}_z$ are diagonal. Then the coupling of the kinetic moments is changed and the transformation matrix of the wave functions of oscillating-type particle pairs is used in order to pass from individual coordinates to coordinates of center-of-mass and relative distance. In these conditions, the further calculation reduces the integrals to expressions containing only magnitudes studied in the literature. (tr-auth)

21530 ANISOTROPY OF THE GAMMA RADIATION IN THE MÖSSBAUER EFFECT. A. Gelberg (Institutul de fizica Atomică, Academiă R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 921-6(1960). (In Rumanian)

The angular distribution of photons transmitted by an absorbent in which the Mössbauer effect takes place is calculated when the source is in a magnetic field. It was shown that the intensity transmitted depends on the angle made by the direction of the magnetic field with the direction of the emission of the gamma rays. The case of the transition $Co^{57} \rightarrow Fe^{57}$ is examined. (tr-auth)

21531 THE CALCULATION OF THE PROBABILITIES OF γ TRANSITIONS OF THE M3 AND β FORBIDDEN TYPE OF THE SECOND ORDER, AS WELL AS MOMENTS OF INERTIA OF THE ATOMIC NUCLEI IN THE NILSSON MODEL. D. Bogdan (Institutul de Fizică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 927-42(1960). (In Rumanian)

The expressions for the probabilities of the γ transitions of the M3 and β forbidden type of the second order of the pure G.T. type ($\Delta\pi = (-1)^{J+1}$) as well as the expression for the moments of inertia in the hypothesis of the rigid nucleus were obtained by using (x', y', z') (ξ, η, ζ). The experimental study of the M3 transitions known at the present in the case of deformed nuclei shows that in this case it is not necessary to use the corrected representation. However, the study of some transitions with small prob-

ability of the M3 and forbidden β type of the second order shows that occasionally, as long as certain selection rules are satisfied, the use of the corrected representation can modify the transition probabilities by a factor of approximately 2. The study shows, moreover, that the moments of inertia are not generally sensitive to the change of the representations used in the Nilsson model. (tr-auth)

21532 THE BOUND STATES OF NUCLEONS IN A NON-AXIAL DEFORMED FIELD. M. Micu and A. Săndulescu (Institutul de Fizică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 957-72(1960). (In Rumanian)

The energy levels and the corresponding eigenfunctions in a completely anisotropic oscillator potential are calculated. The wave functions are expressed by linear combinations of Nilsson wave functions. The values of the energy levels and of the coefficients of corresponding wave functions are tabulated. Two methods permitting the determination of the total wave function are indicated. Formulas expressing the magnetic and quadrupolar moments are obtained. (tr-auth)

21533 ANGULAR DISTRIBUTION OF ELASTICALLY AND INELASTICALLY SCATTERED 6.2-Mev PROTONS ON S^{32}. H. Hulubei, N. Martalogu, M. Ivaşcu, C. Besliu, A. Berinde, I. Neamu, and I. Franz (Institutul de Fizică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 11: 1023-31(1960). (In Rumanian)

The technique of nuclear emulsions was used to study the elastic and inelastic angular distribution of the reaction $S^{32}(p,p')S^{32}$ when the energy of the incident protons was 6.2 Mev. The angular region studied was from 60 to 160° in increments of 10°. The elastic angular distribution shows no peculiarities whereas the inelastic angular distribution indicates a preference for forward scattering. This asymmetry of the inelastic scattering can not yet be compared with the predictions of the theory of direct interaction since it can also be caused by the participation in the reaction of a small number of levels of the compound nucleus. (tr-auth)

21534 ON THE OPTICAL MODEL FOR THE NUCLEON-NUCLEUS SCATTERING. Janusz Dabrowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw and Univ. of Warsaw) and Adam Sobiczewski. Acta Phys. Polon., 20: 243-55(1961). (In English)

The real and imaginary part of the medium and high energy potential for nucleon-nucleus scattering is calculated for an infinite nuclear medium, using phenomenological nucleon-nucleon phase shifts. For the S wave contribution, the exact solution of the equation for the nucleon-nucleon scattering is used for the separable nucleon-nucleon interaction. In calculation of the $l > 0$ contribution to the imaginary part of the optical potential, the Goldberger method is applied. The results are compared with experiment. (auth)

21535 PRESENT STATUS OF THE DECAY CONSTANTS. L. E. Glendenin (Argonne National Lab., Ill.). Ann. N. Y. Acad. Sci., 91: 166-80(Apr. 3, 1961).

The decay constants of the elements used in geochronology (K^{40}, Rb^{87}, U^{235}, U^{238}, and Th^{232}) are examined using two types of liquid scintillation counters. The advantages and difficulties inherent in the use of liquid scintillators are reviewed. The half lives of Rb^{87} and K^{40} are given and future experiments on the U and Th isotopes are described. (T.F.H.)

21536 NUCLEAR ORIENTATION BY OPTICAL PUMPING OF ODD ISOTOPES OF MERCURY. Bernard Cagnac (Université, Paris). Ann. phys., 6: No. 3-4, 467-526 (Mar.-Apr. 1961). (In French)

The method of optical pumping was applied, for the first time with success, to atoms whose ground state is diamagnetic and which possess a nuclear paramagnetism. Hg^{199} and Hg^{201} were the isotopes used. The characteristics of the mercury tubes used and the exact conditions for the optical pumping were described. It is then shown how the curves of the nuclear magnetic resonance observed permit the precise measurement of the nuclear magnetic moments of Hg^{199} and Hg^{201}. The existence of anomalies of the hyperfine structure of the 6^3P_1 and 6^3P_2 levels are deduced. The two methods used for the study of the relaxation—a static and a dynamic method—are described in detail. The origins of the relaxations are studied. (J.S.R.)

21537 GROUND-STATE PROPERTIES OF NUCLEAR MATTER. Robert D. Puff (Massachusetts Inst. of Tech., Lincoln Lab., Lexington). Ann. Phys. (N. Y.), 13: 317-58 (June 1961).

An approximate treatment for the ground state properties of large bound systems is applied to idealized nuclear matter. Expectation values of field operator products or Green's functions are used, in the Martin-Schwinger many-particle formulation, to find the energy, density, and momentum distributions. Effects of the bound nature of the system, as well as pair correlation effects, are included in the treatment. (T.F.H.)

21538 THEORY OF NUCLEAR FISSION. II. THE DEFORMATION OF THE FISSION FRAGMENTS. Witlof Brunner and Harry Paul (Kernphysikalisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Ann. Physik (7), 7: 326-32(1961). (In German)

The total excitation energy E of both fragments (for the fission of U^{235} with thermal neutrons) was calculated with the help of the energy conservation principle—by use of the Fong mass formula for primary fission products—from the experimental data of the mean kinetic energy of the fragments. This energy possesses a sharp minimum for the case that one of the fragments lies in the vicinity of magic nuclei ($N = 82$, $Z = 50$). Under the assumption that the distribution of E on both fragments occurs in proportion to their masses, the deformation of the fragments was determined from E by means of the simple drop model—under consideration of the dependence of the surface tension on the shell structure. The deformation parameter of a fragment shows, as a function of the neutron number of the nucleus considered, characteristic steep slope for the magic neutron numbers. (tr-auth)

21539 THE THEORY OF NUCLEAR FISSION. III. THE DEPENDENCE OF THE NUCLEAR FORCE INTERACTION AND THE KINETIC ENERGY ON THE DEFORMATION. Witlof Brunner and Harry Paul (Kernphysikalisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Ann. Physik (7), 7: 333-41(1961). (In German)

Considerations on the theory of nuclear fission lead to the idea of a depth V_K^0 of the nuclear force potential between both fragments that is dependent on the shell structure of the fragments. From the quantitative pattern of V_K^0 as a function of the mass ratios of the fragments, conclusions were drawn on the deformation of the fission products "in the presence" of their origin—under the assumption that the shell structure is effected essentially by the mechanism of a deformation of the fragments. The results agree with the results of an earlier completely independent semiempirical calculation of the same deformation. With the same deformation parameters, a quantitative understanding of the data on the kinetic energy of the fragments can be obtained. (tr-auth)

21540 MEASUREMENT OF THE HYPERFINE STRUCTURE SPLITTING OF THE $^4F_{9/2}$ GROUND STATE IN THE Co^{59}-I-SPECTRUM AND DETERMINATION OF THE QUADRUPOLE MOMENT OF THE Co^{59} NUCLEUS. Dieter von Ehrenstein (Universität, Heidelberg, Ger.). Ann. Physik (7), 7: 342-52(1961). (In German)

Five of the seven hyperfine structure distances of the electrical ground state a $^4F_{9/2}$ in the Co^{59} I spectrum were measured with a magnetic atomic beam apparatus with the following results: W(F = 8) – W(F = 7) = 3655.470 ± 0.20, W(F = 7) – W(F = 6) = 3169.440 ± 0.05, W(F = 6) – W(F = 5) = 2695.056 ± 0.10, W(F = 5) – W(F = 4) = 2230.638 ± 0.05, and W(F = 4) – W(F = 3) = 1774.548 ± 0.05 Mc. From these distances the magnetic dipole and the electric quadrupole interaction constants were determined as A(a $^4F_{9/2}$) = 450.284 ± 0.01 Mc and B(a $^4F_{9/2}$) = 139.63 ± 0.5 Mc. The metallic cobalt was evaporated from a zirconium oxide crucible heated by electron bombardment. In the calculation of the electric nuclear quadrupole moment of the Co^{59} nucleus (without Sternheimer correction) as Q = 0.404 ± 0.04 × 10^{-24} cm^2, the mixing of the $3d^7\ 4s^2$ a $^4F_{9/2}$ ground state with the states of the $3d^7\ 4s^2$ electron configuration was considered. (tr-auth)

21541 THE γ RADIATION OF ARSENIC-79. Christian Ythier and Ruurd Van Lieshout. Compt. rend., 252: 2543-4(Apr. 24, 1961). (In French)

A scintillation spectrometer study of the γ radiation of As^{79} shows the presence of transitions at 96 ± 5, 360 ± 8, 430 ± 12, and 885 ± 20 kev. (tr-auth)

21542 THE CONVERSION ELECTRON SPECTRA OF Lu^{169} AND Lu^{170}. Z. Plajner, L. Malý, and M. Vobecký (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B11: 128-32 (1961). (In English)

The isotopes Lu^{169} and Lu^{170}, obtained by bombarding a Ta target with fast protons, were studied with a double focusing β spectrometer. The gamma transitions are given together with the relative intensities of the conversion lines. The multipolarity of the transition is determined for some gamma transitions from the internal conversion coefficient ratios of the K and L shells. (auth)

21543 EXCITATION OF LEVELS BY INELASTIC NEUTRON SCATTERING. F. Lehar (Czech. Technical Univ., Prague), J. Palečková, J. Shřivánek, and M. Veselá. Czechslov. J. Phys., B11: 229-43(1961). (In English)

A scintillation spectrometer in ring geometry was used to study the gamma rays accompanying the inelastic scattering of fast neutrons on Na, Mg, Mn, Fe, and I. The energies of the gamma rays were in most cases arranged into the cascade decay schemes of excited nuclei. Some of the transitions, which had not yet been described, were also found. These are the lines (2147 ± 21) kev for Mg^{25}, (2135 ± 22) kev, (2750 ± 40) kev, (3040 ± 50) kev, and 3200 ± 50) kev for Mn^{55}, and a series of other gamma rays emitted during the interaction of fast neutrons with I^{127}. (auth)

21544 DETERMINATION OF THE TOTAL MOMENT OF A SYSTEM OF n PARTICLES FOR THE j^n CONFIGURATION. G. I. Zel'tser (Leningrad Agricultural Inst.). Doklady Akad. Nauk S.S.S.R., 137: 1339-42(Apr. 21, 1961). (In Russian)

The coupling shell model proposed by H. A. Jahn (Proceedings of the Royal Society, A201, p.516 (1950)) and further developed by B. H. Flowers (Ibid. A212, p.248 (1952)) for determining J structures presents considerable difficulties, especially for higher values of j. Formulas have been derived for determining the J structure on the basis of a three dimensional rotation concept which makes it possible to calculate it for an asymmetrical configuration from a symmetrical one having a lesser moment. (TTT)

21545 THE β-DECAY OF STRONGLY DEFORMED NUCLEI. V. G. Solov'ev (Joint Inst. for Nuclear Research, Dubna, USSR). Doklady Akad. Nauk S.S.S.R., 137: 1350-3 (Apr. 21, 1961). (In Russian)

In the superfluid model of the nucleus, all the excited states of the system consisting of N particles are correlated with another system containing the same number of particles, without exceeding an average error of 6%; this correlation was not stipulated in the original formulation of the model. In order to put the error in evidence, the value of log ft was considered for a number of single state transitions between pairs of nuclei. The influence of the matrix elements on the corresponding values of log ft was not completely eliminated in view of the change of the average field during the transition from one nucleus to another. A series of β-decays were tabulated for the following cases: $Tb^{159} \leftarrow Gd^{159}$; $Ho^{161} \leftarrow Er^{161}$; $Np^{237} \leftarrow U^{237}$; $Am^{241} \leftarrow Cm^{241}$; $Bk^{245} \rightarrow Cm^{245}$; $Np^{239} \rightarrow Pu^{239}$; $Np^{237} \leftarrow Pu^{237}$; $Np \rightarrow U^{235}$. Calculation of the pair correlation explains the slowing down of the $Gd^{159} \rightarrow Tb^{159}$ process because the proton and neutron transitions belong to different groups while in case of $Er^{161} \rightarrow Ho^{161}$ both transitions belong to the same group. (TTT)

21546 DECAY OF POLONIUM–BERYLLIUM FAST NEUTRON SOURCES. M. L. Randolph, H. G. Jones, and D. L. Parrish (Oak Ridge National Lab., Tenn.). Health Phys., 5: 45-9(1961).

The half life for fast neutron emission of three Po–Be fast neutron sources was measured by long counter detection methods and found to agree to within less than 2% of the half life of the α-emitter even, in one case, over a period of ten half lives. (auth)

21547 (p,n) REACTIONS ON SOME MEDIUM WEIGHT NUCLEI. B. Lobkowicz and P. Marmier (Laboratorium fur Kernphysik, ETH, Zurich). Helv. Phys. Acta, 34: 85-124(1961). (In German)

The (p,n) reactions for V^{51}, Co^{59}, Cu^{65}, As^{75}, and Zr^{91} were studied by investigating the characteristics of γ rays emitted by the product nucleus. Measurements of coincidences and angular correlations were undertaken, from which it was possible to suggest level schemes for Cr^{51}, Ni^{59}, Zn^{65}, Se^{75}, and Nb^{91}. Comparison of the respective partial cross sections with the statistical theory of nuclear reactions was used to derive information regarding the spins of the excited levels. (auth)

21548 EFFECT OF PARAMAGNETISM ON DIRECTIONAL CORRELATION (MEASUREMENT OF MAGNETIC NUCLEAR MOMENTS OF Dy^{160} AND Er^{166}). W. Kündig (ETH, Zurich). Helv. Phys. Acta, 34: 125-60(1961). (In German)

Angular correlation investigations were undertaken in order to elucidate the influence of extranuclear fields. It is shown that for the γ-γ cascades of Dy^{160} and Er^{166}, most of the observed attenuation effects can be explained by magnetic interaction of the electron shell with the magnetic dipole moment of the nucleus. A method for determining nuclear moments in paramagnetic materials is described. Experimental results indicate that the magnetic field H_0 which influences the nuclear spin precession is the external field $H_{ext.}$ modified by a paramagnetic correction factor: $H_0 = H_{ext.}\,(1 + C'/(T - \Theta))$. The g-factors of the first rotational state of two even-even nuclei were measured; for Dy^{160}, $g_N = 0.46 \pm 0.05$ and for Er^{166}, $g_N = 0.36 \pm 0.06$. The γ-γ angular correlation behavior on reversal of the magnetization of ferromagnetic Tb was investigated. Thence the mean life of the first vibrational state of its

decay product, Dy^{160} was determined as $\tau_N = (1.1 \pm 0.4) \times 10^{-12}$ sec. (auth)

21549 MONOENERGETIC POSITRONS. H. J. Leisi, J. H. Brunner, C. F. Perdrisat, and P. Scherrer (Technische Hochschule, Zürich). Helv. Phys. Acta, 34: 161-88 (1961). (In German)

Experimental proof of a nuclear deexcitation process which is characterized by the emission of monoenergetic positrons is given. This process, predicted by Sliv, was observed following the electron capture decay of Bi^{206} to the 3.403 Mev level of Pb^{206}. From the measured intensity of the K-positron line the ratio of the nuclear life time to the life time of the vacancy in the K-shell was computed. Using data of atomic level widths, the total nuclear life time of the 3.403 Mev state $\tau = 1.8 \times 10^{-15}$ sec. The transition probabilities for gamma rays emitted from this level are computed from the relative transition intensities and compared with some general predictions of the shell model. (auth)

21550 THE GAMMA-RAY SPECTROMETRY OF FISSION PRODUCTS. III. EXPERIMENTAL GAMMA-RAY SCINTILLATION SPECTRA OF U^{235} FISSION PRODUCTS WITH A WELL TYPE NaI(Tl) CRYSTAL. Ichiro Hattori (Ishikawajima-Harima Heavy Ind. Co., Ltd., [Japan]. J. At. Energy Soc. Japan, 3: 253-9(Apr. 1961). (In Japanese)

The gamma radiation from products of slow neutron fission of U^{235} was analyzed with a well type NaI crystal γ ray spectrometer. 0.6 to 500 mg of natural uranium (in the chemical form of U_3O_8) was irradiated for 2 hr by 10^{11} neutrons $\cdot$ cm^{-2} sec^{-1}. The γ ray scintillation spectra between 1 and 200 days after irradiation were recorded and compared with calculated values. In general, the agreement between the spectra was good but there remained some discrepancies. Relative heights of each peak proved that the experimental spectra in the lower energy range were below the calculated values, and the spectra in the higher energy range were greater than the calculated values. The experimental relative height ratio of peak V to peak VIII was about half of the calculated one, so peak V disappeared from the spectra at an earlier time after fission than predicted from the calculation. The relative abundance of Np^{239}, a daughter of an activation product of U^{238}, was three to four times the predicted value. Further, the decay rates of each peak and total counts of gamma radiation from gross fission products were measured, and good agreement was found between the experimental results and the calculated predictions. (auth)

21551 NUCLEAR RELAXATION PROCESSES OF A NONEQUIVALENT TWO-SPIN SYSTEM. Hiroshi Shimizu (Tokyo Univ.) and Shizuo Fujiwara. J. Chem. Phys., 34: 1501-11(May 1961).

Nuclear magnetic relaxation of a two-spin system is discussed using Redfield's semiclassical formulation of the relaxation processes. Time dependences of longitudinal magnetizations are given. An expression for the nuclear induction signal is given from which the expected shape of multiplet lines and their behaviors upon saturation under various origins of the relaxation are discussed. The discussion leads to the conclusion that the mechanism of nuclear relaxation can be determined by carefully analyzing the spin multiplet lines on the basis of the theory. Finally, it is shown that there is a possibility of finding the absolute sign of the spin-spin coupling constant in a two-spin system using the multiple resonance method. (auth)

21552 THE EXCITATION ENERGY OF THE FIRST 2+ LEVEL OF EVEN-EVEN NUCLEI. C. Ythier and R. Van Lieshout (Instituut voor Kernphysich Onderzoek, Amsterdam). J. phys. radium, 22: 23-6(Jan. 1961). (In French)

The variation of the energy of the first excited state in even-even nuclei, as a function of the neutron number, shows a fine structure. The existence of this effect has already been reported by Chupp et al. for the region $96 < N < 126$ and it is confirmed by more recent data. An analogous effect seems to be present in the region $30 < N < 46$. (auth)

21553 STUDY OF THE 11.2-Mev LEVEL OF Si^{28} BY SCATTERING AND ABSORPTION RESONANCES. A. Bussière de Nercy (Faculté des Sciences, Orsay, France). J. phys. radium, 22: 119-21(Feb. 1961). (In French)

The resonant scattering of photons by silicon was studied. The spectrum obtained with a target of natural silicon is shown, and the energy of the excited level was determined with precision to be $E_0 = 11.2 \pm 0.05$ Mev. The angular distribution of the scattered photons was observed from 40 to 140°. This distribution has a predominantly dipolar character which corresponds to spin J = 1. The integrated cross section of Si^{28} was calculated as 5.7 ± 1.1 Mev/mb. (J.S.R.)

21554 FINE STRUCTURES OF PHOTOPROTONS FROM Si^{28}. Katsufusa Shoda, Keisuke Kobayashi, Shoichi Siina, Den Abe, and Motoharu Kimura (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1031-2(May 1961).

The energy spectrum of photoprotons from silicon-28 is investigated using 24 Mev bremsstrahlung. The energy loss is about 30% for 3 Mev and about 10% for 6 Mev protons. The number of detected tracks is 4366 for a scanned area of 1.6 cm^2. The energy spectrum is deduced by the statistical model with the level density ω given by $\omega = C_{exp}(E/2.8)Mev^{-1}$. The many fine structures may be explained by a resonating group model. The cross section of $Si^{28}(\gamma,p)Al^{27}$ is compared with that for $Al^{27}(p,\gamma)Si^{28}$ and the shapes coincide fairly well. (N.W.R.)

21555 THE $C^{13}(p,n)N^{13}$ REACTION CROSS SECTION FROM THRESHOLD TO 13 MeV. P. Dagley, W. Haeberli, and J. X. Saladin (Univ. of Wisconsin, Madison). Nuclear Phys., 24: 353-71(1961). (In English)

The cross section for the $C^{13}(p,n)N^{13}$ reaction is measured at 0° from threshold to 13.1 Mev and at 90° from threshold to 5.3 Mev. Resonances are observed, some of which can be attributed to known states in N^{14}. No indication is found of a neutron group leading to the first excited state in N^{13}, but above 8 Mev there is evidence for neutrons leading to the second or third excited state. In the energy range between threshold and 13 Mev fifty angular distributions of the neutrons leading to the ground state of N^{13} are determined. The angular distributions are similar in shape over energy intervals of two or three Mev. At the end of an interval the angular distributions change character quite suddenly. Over much of the energy range there is pronounced backward peaking with a secondary maximum near 50° and no forward peak. Above 11.4 Mev the angular distributions are in qualitative agreement with a simple direct interaction calculation. The differential cross sections are integrated to give the total cross section for the reaction. (auth)

21556 (d,α) REACTIONS ON C^{12}, O^{16} AND Mg^{24}. F. Pellegrini (Univ. of Pittsburgh). Nuclear Phys., 24: 372-87 (1961). (In English)

The energy spectra of alpha particles from bombardment of C^{12}, O^{16}, and Mg^{24} with 15 Mev deuterons are measured at laboratory angles between 10 and 90°, using an ionization chamber with a resolution in energy of about 1.2%. The alpha groups leading to the 1.74 Mev, T = 1, 0^+ level of B^{10} and to the 2.31 Mev, T = 1, 0^+ level of N^{14} are not observed.

The 2.22 Mev level of Na^{22} is slightly excited for angles of observation less than 40° but for higher angles it appears with an intensity comparable with the intensity of other T = 1 levels of Na^{22}. Angular distributions and absolute cross sections corresponding to the ground, 0.72, 2.15, and 3.58 Mev states of B^{10}; to the ground state of N^{14}; and to the ground, 0.58, 0.89, 1.53, and 2.58 Mev states of Na^{22} are reported. The general shape of these angular distributions indicates that the (d,α) reactions, leading to the low lying states of the residual nuclei, proceed by a direct surface interaction. Attempts are made to fit the data with plane and distorted wave calculations. (auth)

21557 MEASUREMENT OF THE ENERGY OF THE GAMMA RADIATION FROM NEUTRON CAPTURE BY HYDROGEN. J. E. Monahan, S. Raboy, and C. C. Trail (Argonne National Lab., Ill.). Nuclear Phys., 24: 400-11(1961). (In English)

A scintillation spectrometer with an anticoincidence annulus of NaI is used to measure the energy of the gamma ray that follows the capture of a neutron by hydrogen. The measurement is made simultaneously with the calibration of the spectrometer system in terms of six reference gamma rays. The results indicate a value of 2219 ± 2 kev for the binding energy of the deuteron. (auth)

21558 THE 5.3 SEC ISOMER OF W^{183}. C. J. Gallagher, Jr. and H. L. Nielsen (Univ. of Copenhagen). Nuclear Phys., 24: 422-30(1961). (In English)

A 5.3 sec isomer of W^{183} is chemically separated from its parent 5.2 day Ta^{183}. The γ rays from the isomer are observed with a xenon proportional counter and a NaI scintillation crystal. Energies of 46, 52, ≈ 105 and ≈ 160 kev are found. Gamma-gamma coincidence measurements involving the photons are made. On the basis of these results and previous high resolution measurements of the decays of Ta^{183} and Re^{183}, the energy of the isomeric level is assigned as 309.49 kev, and its spin and parity as $^9/_2$+. (auth)

21559 PROTONS AND DEUTERONS FROM Ni^{58} BOMBARDED BY 14.8 MeV NEUTRONS. R. N. Glover and K. H. Purser (Australian National Univ., Canberra). Nuclear Phys., 24: 431-42(1961). (In English)

Using a counter telescope, energy spectra and angular distributions are measured for protons emitted by neutron reactions Ni^{58} at 14.8 Mev. The angular distributions indicate, for the direct interaction contribution, l = 0 and l = 2 transitions to unresolved levels near the ground state of the residual Co^{58} nucleus. Transitions with l = 1 to states of higher excitation demonstrate the presence of odd parity levels. Below 6 Mev proton energy, the distributions are isotropic. Nuclear temperatures of 1.35 ± 0.03 Mev and 0.50 ± 0.03 Mev are found for the reactions (n,pγ) + (n,pn) and (n,np) respectively. The total cross section for proton emission is 830 ± 70 mb. Partial cross sections are: (n,pγ) + (n,pn) 430 mb compound nucleus, 60 mb direct interaction; (n,np) 340 mb. Deuteron emission is established, the total cross section for the (n,d) reaction being 25 ± 6 mb. The angular distribution of the most prominent deuteron group suggests unresolved transitions to the $^7/_2^-$ Co^{57} ground state and a new state at approximately 0.5 Mev. The presence of an l = 1 transition implies approximately 13% p-wave admixture in the Ni^{58} ground state configuration. (auth)

21560 LEVELS IN Ho^{162} AND Dy^{162}. M. Jørgensen, O. B. Nielsen, and O. Skilbreid (Univ. of Copenhagen). Nuclear Phys., 24: 443-55(1961). (In English)

An activity with a half life of 11.8 min, representing the ground state of Ho^{162}, is isolated by a recoil method from the 68 min Ho^{162} activity, which belongs to an isomeric level about 90 kev above the ground state. A decay scheme for the Ho^{162} levels is proposed, indicating the following levels in Ho^{162}: ground state, $(K, I^\pi) = (1, 1^+)$; 38.5 kev $(1, 2^+)$; 86.5 kev (1.3^+); ≈ 90 kev $(6, 6^-)$. In Dy^{162} the following levels are proposed: 81 kev $(0, 2^+)$; 266 kev $(0, 4^+)$; 549 kev $(0, 6^+)$; 1485 kev $(5, 5^-)$. Single-particle assignments in the Nilsson-Mottelson scheme can be proposed for the unpaired particles of the ground state and the 90 kev states of Ho^{162}, and for the 1485 kev level of Dy^{162}, based on the above spins and the fact that the K-capture transitions from Ho^{162} are allowed unhindered. (auth)

21561 ABSOLUTE CROSS SECTION OF THE $K^{39}(n,p)A^{39}$ REACTION FOR 2.5-MeV NEUTRONS. W. R. Dixon and J. H. Aitken (National Research Council, Ottawa). Nuclear Phys., 24: 456-64(1961). (In English)

The cross section for the $K^{39}(n,p)Ar^{39}$ reaction, at a neutron energy of 2.46 Mev, is found to be 96 ± 6 mb. The experimental method consists of taking coincidences between the events in a KI(Tl) scintillation crystal and the He^3 particles that are produced simultaneously with neutrons in the d-d reaction. (auth)

21562 HINDERED E1 DECAY OF THE 6 keV INDIVIDUAL PARTICLE STATE OF $_{73}Ta^{181}$. U. Hauser (California Inst. of Tech., Pasadena). Nuclear Phys., 24: 488-93(1961). (In English)

The half life of the 6.25 kev first excited state of Ta^{181} is determined by a delayed coincidence experiment with a time-to-pulse-height conversion method, and found to be 6.8 ± 0.4 μsec. The E1 gamma transition probability of the state is smaller by a factor of 5×10^5 than the single particle estimate, in qualitative accord with Nilsson's asymptotic selection rules. The normalized transition probability agrees with a factor of five with four other E1 transitions occurring between levels of neighboring nuclei, which are predicted to be almost identical by the unified theory. (auth)

21563 THE DECAY OF Br^{78}. R. Rikmenspoel and D. M. Van Patter (Franklin Inst., Swarthmore, Penna.). Nuclear Phys., 24: 494-9(1961). (In English)

Br^{78} sources are produced by proton bombardment of isotopically enriched (97%) thin targets of Se^{78}, in order to investigate the decay scheme of Br^{78}. The $Se^{78}(p,n)Br^{78}$ threshold is measured at 4.40 ± 0.01 Mev, using a slow-fast neutron counter arrangement. Annihilation radiation with a half-life of 6.5 ± 0.1 min is observed for bombardments with $E_p \geqq 4.40$ Mev. Using an anthracene crystal, the end-point of the β^+ spectrum of Br^{78} is found to be consistent with the value of 2.54 ± 0.01 Mev calculated from the Se^{78}(p,n) threshold determination. Measurements of the γ ray spectrum of Br^{78} indicate a γ ray of 0.613 ± 0.003 Mev, of intensity 0.14 ± 0.015 that of all positrons, which is assigned to the known first 2+ state of Se^{78}. Excitation of the known second 2+ state at 1.31 Mev is not observed, occurring with ≦ 0.4% of the decays, with log ft ≧ 5.9. The results indicate that the ground state of Br^{78} has spin and parity of 1+. (auth)

21564 PROTON CAPTURE IN A^{40}. S. E. Arnell (Chalmers Univ. of Tech., Goteborg). Nuclear Phys., 24: 500-4(1961). (In English)

The $Ar^{40}(p,\gamma)K^{41}$ reaction is studied from 700 to 1400 kev using electromagnetically separated isotopes. Fifty-seven excited levels in K^{41} are observed. The target backing is given special attention. (auth)

21565 AN ABSOLUTE DETECTOR AND PRODUCER OF NUCLEAR ALIGNMENT. B. A. Jacobsohn and R. M.

Ryndin (CERN, Geneva). Nuclear Phys., 24: 505-9(1961). (In English)

For a special type of reaction in which particles of spin one are absorbed or emitted, the consequences of parity and angular momentum conservation are shown to be especially simple and purely geometrical in nature. Such a reaction can serve as an absolute detector of deuteron alignment, as a source of aligned deuterons, or, when followed by a gamma ray, as a source of 100% linearly polarized photons. Some applications are given. (auth)

21566 A DOUBLET AT 3.40 MeV EXCITATION IN Mg^{25}. S. Hinds (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.), R. Middleton, and A. E. Litherland. Nuclear Phys., 24: 510-13(1961). (In English)

The 3.40 Mev level in Mg^{25} is studied by means of the $Al^{27}(d,\alpha)Mg^{25}$ and the $Mg^{24}(d,p)Mg^{25}$ reactions. In both reactions the level is resolved into two components, separated by 9 ± 2 kev, at 3.407 ± 0.007 and 3.398 ± 0.007 Mev. In the (d,p) reaction the level at the lower excitation energy is weakly excited, indicating that the upper member is the $^3/_2^-$ state. In the (d,α) reaction the reverse was observed, the lower level being consistently the stronger. The relative intensities of the members of the doublet in the (d,α) reaction suggest that the new level in Mg^{25}, at 3.398 ± 0.007 Mev, has spin $^9/_2$ and consequently corresponds to the 3.44 Mev ($^9/_2^+$) level in the mirror nucleus Al^{25}. (auth)

21567 HIGH ENERGY GAMMA RAYS IN THE DECAY OF 27h Ho^{166}. P. G. Hansen (Research Establishment, Risø, Denmark), K. Wilsky, D. J. Horen, and Lung-Wen Chiao. Nuclear Phys., 24: 519-23(1961). (In English)

The gamma spectrum of 27 hr Ho^{166} is investigated by means of a three-crystal pair-spectrometer and coincidence techniques. Two gamma rays with energies of 1747 ± 5 and 1825 ± 5 kev establish a new level at 1826 kev in Er^{166}. The log ft value for the β decay to this state is $5.2^{+0.3}_{-0.4}$ and suggests an allowed, unhindered transition. Single particle assignments for this level are discussed. (auth)

21568 TRANSIENT EFFECTS IN NUCLEAR MAGNETIC RESONANCE WITH THE ROTATING CO-ORDINATES METHOD. G. Bonera and P. De Stefano (Università, Pavia, Italy). Nuovo cimento (10), 20: 316-23(Apr. 16, 1961). (In English)

Transient effects in nuclear magnetic resonance are studied by the rotating coordinates method. A description of the motion of the nuclear magnetization during the transition is given by means of kinematic models. (auth)

21569 PHYSICAL ONE-NUCLEON AND TWO-NUCLEON WAVE FUNCTIONS IN FIXED SOURCE THEORY. J. Mandelbrojt (CERN, Geneva). Nuovo cimento (10), 20: 366-74 (Apr. 16, 1961). (In English)

Non-perturbative approximations of the physical one-nucleon and two-nucleon wave functions in fixed source theory are given. The states are given in an analytic form, from which expectation values of operators can be calculated in an explicit closed form. (auth)

21570 THE EFFECT OF THE EXCLUSION PRINCIPLE ON THE REAL PART OF THE OPTICAL POTENTIAL. J. Dabrowski (Univ. of Warsaw) and A. Sobiczewski. Nuovo cimento (10), 20: 403-7(Apr. 16, 1961). (In English)

The exclusion principle is applied to the real part of the optical potential (ReV_0) in nucleon-nucleus (N-nucleus) scattering. The N-N scattering matrix, t, in the nuclear medium can be approximated from the free N-N scattering matrix t_0. The effect of the exclusion principle on ReV_0 is calculated for incoming nucleon energies up to 250 Mev; the effect is appreciable up to ~150 Mev. (T.F.H.)

21571 NEUTRON SCATTERING FROM ISOTROPIC LATTICES. R. Subramanian (Atomic Energy Establishment, Trombay, India). Phys. and Chem. Solids, 19: 173-80(May 1961). (In English)

To study theoretically the scattering of neutrons from a solid, a model based on the Born von Karman theory of lattice vibrations is applied. Some of the integrals involved cannot be evaluated analytically and therefore are computed on the T.I.F.R. electronic computer. The results are presented here with particular reference to neutron scattering from beryllium and magnesium. The agreement with experimental data is very good for cold and thermal neutron scattering from the crystals at room temperature but not so good for other crystal temperatures and higher neutron energies. (auth)

21572 ATOMIC-BEAM INVESTIGATIONS OF ELECTRONIC AND NUCLEAR GROUND STATES IN THE RARE-EARTH REGION. Amado Y. Cabezas, Ingvar Lindgren, and Richard Marrus (Univ. of California, Berkeley). Phys. Rev., 122: 1796-1801(June 15, 1961). (UCRL-9225)

A number of radioactive isotopes in the rare-earth region are investigated, using the atomic-beam magnetic-resonance technique. The total electronic angular momentum (J) and the atomic g value (gJ) are determined for some low-lying levels in, Pm, Dy, Ho, and Er. These observations are consistent with the following ground-state assignments: PmI– $(4f)^5(6s)^2$, $^6H_{5/2}$; DyI– $(4f)^{10}(6s)^2$, $^5I_8$; HoI– $(4f)^{11}(6s)^2$, $^4I_{15/2}$; and ErI– $(4f)^{12}(6s)^2$, $^3H_6$. The ground-level assignments agree with the Hund's-rule predictions, and the g values approximate the Landé values well. Experimental knowledge concerning electronic ground states in the rare-earth region is summarized. The following nuclear spin (I) values are obtained: Pm^{149}, $^7/_2$; Pm^{151}, $^5/_2$; Gd^{159}, $^3/_2$; Tb^{160}, 3; Dy^{165}, $^1/_2$; Dy^{166}, 0; 27 hr Ho^{166}, 0; Er^{169}, $^1/_2$; Er^{171}, $^5/_2$; and Tm^{171}, $^1/_2$. These values are compared with beta-decay results. Most of these isotopes have large nuclear deformations, and the spin values are discussed in relation to the single-particle energy-level diagrams given by Nilsson. A few results are explained with the shell model. (auth)

21573 EXCITATION FUNCTIONS OF THE (p,pn) AND (p,2p) REACTIONS ON Ce^{142} AT 60-233 MEV. William R. Ware and Edwin O. Wiig (Univ. of Rochester, N. Y.). Phys. Rev., 122: 1837-41(June 15, 1961).

The cross sections of the reactions $Ce^{142}(p,pn)Ce^{141}$ and $Ce^{142}(p,2p)La^{141}$ are determined at 60, 120, 180, 200, and 233 Mev. A comparison is made of the observed yields with those predicted on the basis of Monte Carlo cascade-evaporation calculations at 83, 238, and 368 Mev. For protons of energy between 60 and 240 Mev the agreement is better for the (p,pn) reaction than for the (p,2p) reaction. (auth)

21574 DECAY SCHEME OF Sn^{113}. R. C. Greenwood and E. Brannen (Univ. of Western Ontario, London). Phys. Rev., 122: 1849-52(June 15, 1961).

The electron capture decay of Sn^{113} was investigated using scintillation detectors and coincidence circuitry. Decay was found to occur to the 650 and 393 kev states of In^{113} with branching ratios of (1.8 ± 0.1)% and (98.2 ± 0.1)% respectively. The 650 kev state decayed by the emission of a 255 kev gamma ray to the 393 kev state. No evidence was found for the existence of a proposed 648 kev crossover transition. An upper limit for the intensity of this transition was placed as 0.1% of that of the 255 kev transition. The orbital electron capture ratio to the 648 kev state was determined to be $(P_{LMN...}/P_K)<0.19$. From this value, a minimum decay energy to the 648 kev state was assigned as 150 kev. It was determined that transitions to the 393

ev state of In^{113} were first forbidden by considering log ft alues; this was consistent with a spin and parity of $\frac{1}{2}$+ or $\frac{9}{2}$+ for the ground state of Sn^{113}. The 648 kev state was ssigned a spin and parity of $\frac{1}{2}$− or $\frac{3}{2}$− on the basis of ossible log ft values for the absence of the 648 kev cross-ver transition. (auth)

21575 INTERACTION OF NEUTRONS WITH He^3. A. R. ayres, K. W. Jones, and C. S. Wu (Columbia Univ., New ork). Phys. Rev., 122: 1853-62(June 15, 1961).

Spectra of the n+He^3 reactions were obtained for mono-nergetic neutron fluxes of 0.95, 2.67, 5,00, 8.07, and 17.5 lev, using a He^3-filled proportional counter. Analysis of ese spectra yielded the ratios to the total cross section f the total elastic, the $He^3(n,p)H^3$, and the $He^3(n,d)D$ re-ction cross sections. Absolute cross sections were ob-ained by normalization to the known total cross section. ifferential elastic scattering cross sections for neutrons n He^3 were obtained through the relationship between the cattering angle of the neutron and the observed energy of e He^3 recoil in the counter filling. These angular dis-ributions were compared with the theoretical angular dis-ributions. The experiment was intended to discriminate etween two special cases for the theoretical potential nteraction, namely the symmetrical exchange force and e Serber exchange force. The experimental results fa-ored the Serber exchange force. The results are com-ared with cross sections calculated from inverse reactions nd direct measurements. (auth)

21576 DECAY OF I^{132}. R. L. Robinson, E. Eichler, nd Noah R. Johnson (Oak Ridge National Lab., Tenn.). hys. Rev., 122: 1863-71(June 15, 1961).

The decay of I^{132} is investigated by means of scintillation pectrometers. Energies (and relative intensities) of the amma rays are 0.240(1.3), 0.518(15), 0.667(100), 0.72(5), .775(63), 0.953(15), 1.14(1.2), 1.142(2.7), 1.30(2.4), 1.392 3.4), 1.45(1.1), 1.75(0.3), 1.91(0.7), 1.99(0.8), 2.08(0.18), .18(0.13), and 2.39(0.11) Mev. The data indicate that the amma peak at 0.667 Mev actually consists of four gamma ays with energies between 0.62 and 0.68 Mev. An energy evel diagram of Xe^{132} based on the present spectral studies nd gamma-gamma angular correlation measurements is roposed. Energies (and spins) of the levels are 0.673(2+), .32, 1.448(4+), 1.81, 1.966(3), 2.10(3 or 4), 2.401(4), 2.59 3), and 2.84(3, 4, or 5) Mev. (auth)

21577 HALF-LIFE OF B^{12}, Na^{24m}, AND As^{75m}. Alois V. Schardt (Los Alamos Scientific Lab., N. Mex.). Phys. ev., 122: 1871-4(June 15, 1961).

The following half-lives were measured: B^{12}, 20.31 ± .20 msec; the 472 kev level of Na^{24}, 19.9 ± 0.3 msec; and e 305 kev level of As^{75}, 16.8 ± 0.4 msec. The activities ere produced by a pulsed beam from a Van de Graaff enerator. The data were taken with gated radiation-etection circuits in conjunction with a time-delay analyzer, nd the half-lives were determined by least-squares nalysis. (auth)

21578 EXCITATION FUNCTIONS OF THE (p,2p6n) AND (p,3p5n) REACTIONS FOR 60-, 100-, 150-, AND 240-MEV PROTONS ON ENRICHED ZIRCONIUM-90. Envare Jnseren and Edwin O. Wiig (Univ. of Rochester, N. Y.). hys. Rev., 122: 1875-6(June 15, 1961).

The cross sections of the $Zr^{90}(p,3p6n)Sr^{83}$ and Zr^{90} p,2p6n)Y^{83} reactions are determined at 60 to 240 Mev. he cross section for even-odd Sr^{83} production at 100 to 40 Mev is 1330 to 2140 times as large as that of odd-even ^{83}. (auth)

21579 ABSOLUTE CROSS SECTIONS OF THE REACTIONS $Na^{23}(n,p)Ne^{23}$ AND $Na^{23}(n,\alpha)F^{20}$. Claude F. Williamson (Univ. of Texas, Austin). Phys. Rev., 122: 1877-82(June 15, 1961).

The absolute cross sections for the competing reactions $Na^{23}(n,p)Ne^{23}$ and $Na^{23}(n,\alpha)F^{20}$ are measured at 4 to 19 Mev by the activation method, using neutrons from the $H^2(d,n)He^3$, $N^{14}(d,n)O^{15}$, $C^{14}(d,n)N^{15}$, and $H^3(d,n)He^4$ reactions. The excitation curves thus obtained are compared with theoretical results based upon the statistical theory. A fit is obtained for the (n,p) reaction, but discrepancies exist between the measured and calculated (n,α) cross sections. (auth)

21580 TEST OF ISOTOPIC SPIN CONSERVATION FROM AN EXPERIMENT LIMIT ON $\sigma(d + d \rightarrow He^4 + \pi^0)$. John A. Poirier and Morris Pripstein (Univ. of California, Berkeley). Phys. Rev., 122: 1917-18(June 15, 1961). (UCRL-9544)

The reaction $d + d \rightarrow He^4 + \pi^0$, which is forbidden by isotopic spin conservation is sought. A beam of deuterons at 460 Mev is scattered from an extended target filled with deuterium gas at 25 atm pressure and at liquid-nitrogen temperature. The differential cross section in the center-of-mass system at 90° is measured and a value of $(18 \pm 2.3) \times 10^{-34}$ cm^2/sr is obtained. This value is considered to be an upper limit for the reaction; the data are consistent with no π^0 production. From a comparison of this upper limit with the theoretical prediction of the cross section for this reaction if isotopic spin need not be conserved, it is concluded that isotopic spin is at least 93.5% conserved. (auth)

21581 THEORY OF CONSERVATION OF ISOTOPIC SPIN FROM d + d REACTIONS. K. R. Greider (Univ. of California, La Jolla). Phys. Rev., 122: 1919-20(June 15, 1961).

The theoretical cross section for the reaction $d + d \rightarrow He^4 + \pi^0$ is calculated in the impulse approximation. It is assumed that the matrix element contains no isospin dependence which, due to conservation laws, would ordinarily prohibit pion production. The comparison of the theoretical and experimental cross sections for the reaction yields an upper limit of 6.5% for the amount of isospin nonconservation in strong interactions. A discussion of the effects of different He^4 wave functions in the calculation is also included. (auth)

21582 SPIN-ORBIT INTERACTION IN TWO-PION EXCHANGE NUCLEAR POTENTIAL. Suraj N. Gupta (Wayne State Univ., Detroit). Phys. Rev., 122: 1923-6 (June 15, 1961).

The spin-orbit interaction term in the two-pion exchange nuclear potential is derived. It is found that while the spin-orbit force is quite small in the triplet odd states, it is large and repulsive in the triplet even states. The relationship of the pion theoretical result with the phenomenological spin-orbit interaction is discussed. (auth)

21583 FERMI-THOMAS TYPE APPROXIMATION FOR NUCLEI. Kailash Kumar (Australian National Univ., Canberra), and Rajat K. Bhaduri. Phys. Rev., 122: 1926-9 (June 15, 1961).

The Hartree-Fock to Fermi-Thomas reduction is carried through for finite nuclei, starting with the K-matrix formulation. The resulting expression accurately represents the nuclear energy, in terms of the density and its first derivatives only; this expression differs in detail from the semi-empirical expressions proposed for this purpose. This

expression shows the inadequacy of the "semi-infinite" approximation. (auth)

21584 INELASTIC SCATTERING OF 18.9-MEV NUCLEONS FROM THE 9.6-MEV STATE OF C^{12}. E. Bradford and B. A. Robson (Australian National Univ., Canberra). Phys. Rev. Letters, 6: 550-1(May 15, 1961).

An optical model analysis of the inelastic scattering of 18.9-Mev protons from the 9.6-Mev excited state of C^{12} is presented. The direct-interaction two-body potential is assumed to be zero-ranged and spin-independent, and all forms of exchange are neglected. It is concluded that the 9.6-Mev state has spin and parity $J^{\pi} = 3^-$. (T.F.H.)

21585 OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF 5.5 Mev He^3 BY CARBON, MAGNESIUM, ALUMINIUM AND COPPER. P. E. Hodgson (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 77: 997-1000(May 1, 1961).

Measurements of He^3 scattering by nuclei are analyzed using the optical model of the interaction, and the values of the potential parameters giving the best fit to the data are obtained. (auth)

21586 TWO CHANNEL FIVE NUCLEON REACTIONS WITH CENTRAL FORCES. W. Laskar (Univ. Coll., London), C. Tate, B. Pardoe, and P. G. Burke. Proc. Phys. Soc. (London), 77: 1014-23(May 1, 1961).

The two-channel five-nucleon reaction is formulated using the resonating group method and including the two groupings dt, nHe^4. The central potential used is of Gaussian shape with exchange dependence. The wave functions for the nuclear ground states are Gaussian (double Gaussian for the deuteron and single Gaussian for t and He^4), the parameter being determined by variational methods to fit the binding energies. Coupled integro-differential equations are derived for each value of the total spin and angular momentum of the corresponding system. Numerical results are given. (auth)

21587 THE ANGULAR DISTRIBUTIONS OF ALPHA PARTICLE GROUPS FROM THE REACTION $Mg^{24}(He^3,\alpha)Mg^{23}$. G. Parry, H. D. Scott, and S. Swierszczewski (Univ. of Liverpool). Proc. Phys. Soc. (London), 77: 1024-7(May 1, 1961).

Angular distributions of two alpha-particle groups from the reaction $Mg^{24}(He^3,\alpha)Mg^{23}$ at 5.5 Mev incident beam energy are measured by magnetic analysis. For both groups a peak is observed in the forward direction, but for one of the groups an additional peak is observed at large angles. An attempt is made to explain the results in terms of a direct interaction mechanism. (auth)

21588 A STUDY OF THE REACTION $Ca^{40}(d,n)Sc^{41}$. B. E. F. Macefield, J. H. Towle, and W. B. Gilboy (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 1050-61(May 1, 1961).

The neutron time-of-flight technique is used to study the reaction $Ca^{40}(d,n)Sc^{41}$. A ground state Q value of -1.145 ± 0.015 Mev is obtained. Excited states of Sc^{41} are located at 1.709 ± 0.030 and 2.476 ± 0.030 Mev. Angular distributions of the corresponding neutron groups are measured. The application of Butler stripping theory enables an assignment of $l = 3$ for the captured proton for the ground state and $l = 1$ for the 1.71 Mev state. An unambiguous assignment is not possible for the 2.48 Mev state. (auth)

21589 THE NUCLEAR ZEEMAN EFFECT, AND QUADRUPOLE SPLITTING IN Sn^{119}. A. J. F. Boyle, D. St. P. Bunbury, and C. Edwards (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 77: 1062-8(May 1, 1961).

The recoilless absorption of 24 Mev γ rays from Sn^{119m} is studied, using a velocity spectrometer. Observations with the absorbing nuclei in different environments enable a value of 0.83 ± 0.03 n.m. to be given for the magnetic moment of the first excited state in Sn^{119}, and an upper limit of 3×10^{-8} ev to be put on the interaction energy between the quadrupole moment of this state and the gradient of the electric field in metallic tin. (auth)

21590 KINETIC ENERGY EFFECTS IN THE THERMAL NEUTRON FISSION OF U^{235}. T. J. Gooding (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 77: 1097-8(May 1, 1961).

An experiment is described in which the effects of varying the total fission product kinetic energy are studied, for thermal neutron fission of U^{235}. The fission product mass curves are given for total kinetic energy of 154, 166, 175, and 180 Mev. The peak-to-valley ratio is found to increase by a factor >10 over the energy range studied. It is suggested that deep valleys may be caused by formation of nuclei with mass numbers near 132, with near-magic-number $Z \simeq 50$ and $N \simeq 82$. (T.F.H.)

21591 GROSS STRUCTURE IN THE PROTON SPECTRA FROM THE $V^{51}(d,p)V^{52}$ REACTION. A. W. Dalton, G. Parry, and H. D. Scott (Univ. of Liverpool). Proc. Phys. Soc. (London), 77: 1098-1100(May 1, 1961).

The proton spectra from the reaction $V^{51}(d,p)V^{52}$ at 8.9 Mev are studied. After removal of impurity effects, groups are found in the spectra at Q-values of 0.64 and 2.23 Mev corresponding to $l = 2$ for the ingoing neutron; 1.3, 3.45, 4.27, and 5.07 Mev corresponding to $l = 1$; and no groups corresponding to $l = 0$. (T.F.H.)

21592 ON THE EMISSION OF FAST Σ-HYPERONS FROM DISINTEGRATIONS DUE TO THE CAPTURE OF K^--MESONS BY LIGHT NUCLEI. D. Evans (Univ. of Bristol, Eng.), B. D. Jones, B. Sanjeevaiah, J. Zakrzewski, M. J. Beniston, V. A. Bull, and D. H. Davis. Proc. Roy. Soc. (London), A262: 73-83(June 13, 1961).

A study was made of disintegrations produced in photographic emulsion by the nuclear capture at rest of K^- mesons, from which fast charged Σ hyperons are emitted. In a sample of 63 events, six were analyzed unambiguously as being due to absorption in carbon, nitrogen, or oxygen without the emission of any neutrons. An additional eight were found to be consistent with capture by a light nucleus with the emission of one neutron only in each case. The fraction of disintegrations due to K^- capture in light nuclei from which a fast charged Σ hyperon is emitted is estimated. (auth)

21593 CALCULATING ENERGY RELEASED BY FISSION PRODUCTS. K. Shure and D. J. Dudziak (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 30(June 1961).

21594 DETERMINATION OF α FOR U-235 IN AN INTERMEDIATE ENERGY SPECTRUM BY ANALYSIS OF URANIUM FUEL FROM A Be-MODERATED INTERMEDIATE SPECTRUM LATTICE. E. C. Hansen, E. B. Fehr, D. G. Miller, and F. M. Rourke (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 131(June 1961).

21595 INVESTIGATIONS OF (n,p) AND (n,α) REACTIONS IN CsI WITH NEUTRONS FROM 12.1 TO 19.6 Mev. M. Bormann and R. Langkau (Institut für Experimentalphysik, Hamburg). Z. Naturforsch., 16a: 444-5(Apr. 1961). (In German)

A preliminary report is given on new investigations of (n,p) and (n,α) reactions on CsI crystals with neutrons in

e energy range from 12.1 to 19.6 Mev. The experimental rrangement permitted the measurement of the absolute oss sections. As examples, the α spectra obtained for actions with 14.1 and 18.0 Mev neutrons are shown. The sults are discussed on the basis of the Blatt and Weiss-pf representation of the Weisskopf-Ewing evaporation eory. (J.S.R.)

1596 THE GYROMAGNETIC RATIO OF THE 137-EV ROTATION LEVEL OF Os^{186}. E. Bodenstedt, H.-J. örner, G. Strube, C. Günther, J. Radeloff, and E. Gerdau Universität, Hamburg). Z. Physik, 163: 1-16(1961). (In erman)

The rotation of the angular correlation of the 631 to 137 v γ-γ cascade in the decay of Re^{186} in an external mag-tic field of 53,500 gauss was determined to be $\omega\tau$ = 098 ± 0.008. The half life of the 137 kev level was meas-ed as: $T_{\frac{1}{2}} = (0.84 \pm 0.03) \times 10^{-9}$ sec. The coincidences tween the 137 kev γ radiation and the β group of 927 kev aximum energy were used in connection with a time to lse height converter circuit. The coefficients of the gular correlation of the 631 to 137 kev γ-γ cascade were und as: $A_2 = -0.073 \pm 0.010$; $A_4 = +0.310 \pm 0.014$. These lues imply corrections for 3.9% admixture of internal emsstrahlung and a 1% contribution by K x-radiation. ne solid angle corrections were done according to the rmula given by E. Rose. The comparison with the theo-tical coefficients for a (2^+ 2^+ 0^+)-cascade shows that the ultipolarity of the 631 kev radiation is pure E2, the M1 dmixture being less than 0.1%. This result is in agree-ent with the K selection rule. There is no appreciable tenuation by internal fields. The comparison with the eoretical angular correlation gives for the integral atten-tion factor: $G_4 = 0.95 \pm 0.04$; assuming only attenuation electric quadrupole interaction, one gets $G_2 = 0.92 \pm$ 07. The nuclear g factor of the 137 kev rotational state as derived from these results without any further cor-ction as: $g_R = +0.316 \pm 0.028$. (auth)

1597 MOSSBAUER EFFECT FOR Ni^{61} WITH APPLIED AGNETIC FIELDS. Horst H. F. Wegener and Felix E. penshain (Oak Ridge National Lab., Tenn.). Z. Physik, 3: 17-26(1961). (In English)

It was recently shown that the 71-kev γ radiation of Ni^{61} as suitable for the Mossbauer effect. The Mossbauer pectrum M(v) in nickel is approximately five times roader than the natural line width. This broadening was used by magnetic hyperfine structure splitting. By ap-ication of external magnetic fields the usually unoriented ternal field responsible for the splitting was polarized. arious polarizations gave different forms of the spectrum (v). In an appendix, M(v) is given for E1, M1, E2, and M2 radiation as a function of the nuclear spin, the magnetic oment, and the magnetic field in source and absorber. or Ni^{61} one obtains, according to the field geometry ap-ied, 7, 14, 21, or 35 different lines which are so closely djacent that they can not be resolved. Nevertheless the easured form of M(v) yields information on the internal agnetic field H in nickel metal and on the nuclear mo-ents μ_e (excited state) and μ_g (ground state). The ratio $/\mu_g = -0.47 \pm 0.08$, the product $(\mu_g \cdot H)(h \cdot j_g) = 26.0 \pm$ 6 Mc/sec, and the direction of H, opposite to the macro-opic magnetization, are found. The value for $(\mu_g \cdot H)$ is in tisfactory agreement with magnetic nuclear resonance easurements. (tr-auth)

1598 SOME REMARKS ON THE THEORY OF THE OSSBAUER EFFECT. Joachim Petzold (Universität, eidelberg, Ger.). Z. Physik, 163: 71-6(1961). (In erman)

Although the life time τ of an excited nucleus is finite, and the coherence length of the emitted γ ray is of the order of $1/\tau$, the reaction of the γ emission on the motion of the emitting nucleus is momentary. Some Mossbauer experiments are proposed by which properties of a crystal could be measured. (auth)

21599 HYPERFINE STRUCTURE SPLITTING OF RECOILLESS γ LINES. II. THE 8.42-KEV LEVEL IN Tm^{169}. M. Kalvius, P. Kienle, K. Böckmann, and H. Eicher (Technische Hochschule, Munich). Z. Physik, 163: 87-91(1961). (In German)

Recoilless nuclear resonance absorption in the 8.42-kev level of Tm^{169} was observed. By measuring resonance absorption as a function of Doppler displacement between emitter and absorber, a hyperfine structure splitting of the 8.42-kev γ line was found through the field of the paramagnetic ions in the oxide crystal. (tr-auth)

21600 A FORTRAN PROGRAM FOR ELASTIC SCATTERING ANALYSES WITH THE NUCLEAR OPTICAL MODEL. University of California Publications in Automatic Computation No. 1. Michel A. Melkanoff, John S. Nodvik, David S. Saxon, and David G. Cantor. Berkeley and Los Angeles, University of California Press, 1961. 121p. $4.50

A detailed description of a FORTRAN code named Program SCAT 4 for analyzing elastic scattering of various particles against complex nuclei by means of the diffuse surface optical model of the nucleus is presented. Program SCAT 4 calculates in the center-of-mass system the differential elastic scattering cross sections, the polarization, and the total reaction cross section for particles of spin 0 or ½ having any mass, charge, and (non-relativistic) energy scattered by spinless nuclei of any mass and charge. The incident and target particles are assumed to interact through a two-body potential consisting of a complex nuclear potential which includes spin-orbit interaction and whose shape can be specified by input parameters. The calculations include numerical integrations of the radial Schroedinger equations for the effective partial waves. The program was written for an IBM 704 with floating point traps or an IBM 709, with a 32,768-word memory, no drum, and a minimum of 2 tape units. (M.C.G.)

21601 THE PRINCIPLES OF NUCLEAR MAGNETISM. A. Abragam. The International Series of Monographs on Physics. Oxford, At The Clarendon Press, 1961. £4. 4s.—New York, Oxford University Press, 1961. 613p. $13.45.

The principles and methods of nuclear magnetism are presented mainly in theory, however, a large amount of experimental evidence is included for the sake of a careful comparison with the theory. The purpose is to give a consistent description of the magnetic properties of atomic nuclei. The following topics are included: motion of free spins, macroscopic aspects, transient methods, dipolar line width in a rigid lattice, spin temperature, electron-nucleus interactions, fine structure of resonance lines—quadrupole effects, thermal relaxation in liquids and gases, thermal relaxation and dynamic polarization in solids, theory of line width in the presence of motion of the spins, multiplet structure of resonance lines in liquids, and the effects of strong radio-frequency fields. (N.W.R.)

Particle Accelerators

21602 (AFOSR-719) PRELIMINARY REPORT ON THE INVESTIGATION OF THE FEASIBILITY OF AN ELECTROSTATIC ACCELERATOR FOR ACCELERAT-

ING MICRON-DIAMETER PARTICLES. PART I. VAN DE GRAAFF GENERATOR. PART II. CHARGING OF MICRO PARTICLES. G. K. Jesperson, D. W. Reid, R. W. Grow, and E. P. Palmer (Utah. Univ., Salt Lake City). Nov. 15, 1960. Contract AF49(638)-462. 144p. (OSR-20)

I. An electrostatic generator of the Van de Graaff type was built. The generator charges to 600,000 volts and delivers 70 μa when negatively charged. When positively charged the generator delivers 10 μa at 475,000 volts. The maximum charge the belt will carry was found to be about 50% of the theoretical value. It was shown, by the use of electric field maps, that the generator voltage has very little effect on the amount of charge lost in transit from the lower to the upper oblate. It was shown that most of the charge is lost before the belt leaves the lower oblate. An equivalent circuit is proposed which predicts the voltage attainable by the generator. All parameters in the equivalent circuit are shown to be a function of belt speed only. Agreement is good between predicted and measured performance values at low belt speeds. At the upper belt-speed limit of 4,000 ft/min, errors of 30% are noted. II. An electrostatic particle-accelerator was built for hypervelocity impact studies. The particles used are carbonyl-iron spheroids having an average diameter of 3 microns and a density of 7.8 gm/cm^3. An injector was built which consists of two parallel plates separated by an insulating washer. The application of 2,000 volts d-c across the plates causes the particles to oscillate between them. This motion injects the particles into the system when their path lines up with a small hole in the lower plate. The particles are accelerated by a large d-c voltage developed between two large oblate spheroids by a Van de Graaff generator. The Van de Graaff generator produces voltages up to 600,000 volts negative. To measure the charge on the particles and also their velocity, a small section of $\frac{1}{8}$ in. copper tubing is enclosed in a grounded shield. The passage of a charged particle through the tubing induces a voltage pulse whose height is proportional to the charge on the particle and whose length is a measure of the time required for the particles to travel the length of the tubing. (auth)

21603 (INS-TH-28) DESIGN STUDY ON THE DRIFT TUBE OF INJECTOR LINAC FOR INS ELECTRON SYNCHROTRON. (Tokyo Univ. Inst. for Nuclear Study). Sept. 25, 1957. 66p.

The design study is described for the drift tubes of the linear accelerator for the injector of a 1-Bev electron synchrotron. (auth)

21604 (INS-TH-29) DESIGN OF THE PULSED POWER SUPPLY FOR KLYSTRON AMPLIFIER (I). A. Miyahara, T. Tanaka, and T. Nishikawa (Tokyo Univ. Inst. for Nuclear Study). Sept. 25, 1957. 10p. (In Japanese)

The preliminary design study is presented of the pulser for the pumped klystron amplifier used for the INS-Linac. (auth)

21605 (JINR-P-371) FIZICHESKIE OSNOVY ANTIPROTONNOGO KANALA. (Physical Principles of Antiproton Channel). V. N. Zubarev, V. S. Kladnitskii, A. B. Kuznetsov, S. V. Mukhin, L. S. Okhrimenko, N. B. Rubin, and I. N. Semenyushkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 23p.

A method for separating high-energy antiprotons from a π-meson background in a synchrotron is described. Conditions for producing a satisfactory ratio of average pulse spacing to average pulse duration, the ion-optical system, the deflecting device, and other conditions necessary for realizing the suggested method are studied. A spatial separation of antiprotons and π mesons with 3.1 ± 0.1 Bev/c was achieved. The divergence between the image centers of antiproton and π meson beams is 13.5 cm with a clearance between the image inner edges of about 9 cm. The anticipated π background damping coefficient is ≳700. (tr-auth)

21606 (TID-12685) YALE STUDY ON HIGH INTENSITY PROTON ACCELERATORS. R. L. Gluckstern (Yale Univ., New Haven). Apr. 20, 1961. Contract [AT-(30-1)-2726]. 19p.

A description is given of a method, similar to that of Christofilos, which is used to allow the calculation of a drift tube as a surface everywhere perpendicular to an electric field configuration given by an exact expansion. The field pattern is taken to be that associated with the apparent function of the drift tube, i.e., to supply a dipole field configuration. (B.O.G.)

21607 ON THE PROBLEM OF A CYCLOTRON FOR PARTICLES WITH RELATIVISTIC INCREASE IN MASS. L. Krlin (Research Inst. of Vacuum Electronics, Czechoslov. J. Phys., B11: 244-52(1961). (In English)

The problem of circular accelerators with time constant magnetic field and constant frequency of the accelerating voltage is discussed. An analysis is made of the possibility of compensating the change in time of revolution (caused by the increase in mass during energy growth) by simultaneous axial and radial displacement of the equilibrium orbit. It is found that the problem can be solved only with certain approximations. The approximate numerical parameters of the accelerator are given and the approximations used are discussed. (auth)

21608 PARTICLE ACCELERATORS. [PART] I. Francisco Verdaguer. Energia nuclear (Madrid), 5: No. 17, 12-19(Jan.-Mar. 1961). (In Spanish)

Some properties of nuclei and the interpretation of nuclear reactions are briefly considered. The elementary particles known at the present time are tabulated, together with their rest masses, spins, decay products, and mean lives. (J.S.R.)

21609 AN IONIC FREQUENCY CONVERTER FOR FEEDING A BETATRON. V. G. Stepanov and A. A. Kukhtin. Izvest. Tomsk. Politekh. Inst. im. S. M. Kirova, No. 96, 119-29(1959).

A series of circuits is proposed of ionic frequency converters for feeding a betatron, which do not comprise an inverter unit and make it possible to produce frequencies of 150, 300, 450 cps and more. The description is given and a detailed analysis is performed of two types of circuits of valve frequency converters. The first circuit makes it possible to obtain at the output one-phase voltage of tripled frequency; such a converter consists of two three-phase controlled ionic rectifiers operating alternately with 120° electric lag angle. In the circuits of the second type, both half-periods of the transformer secondary winding are utilized. Such circuits can be applied to converters with the frequency ratio $f_2/f_1 = 3, 5, 7, 9$, etc. A comparison of the frequency conversion circuits is carried out. The calculation methods of the typical transformers and the conversion power coefficients are presented. The linear diagrams of the secondary transformer phase voltages and the voltages at the converter output are given. Results from experimental investigation are presented for a circuit built with thyratrons. The circuits proposed have lower cost, larger efficiency, higher simplicity, and reliability in comparison with circuits having an inverter unit. (auth)

21610 PRELIMINARY OPERATION OF A FOUR-SECTOR RACETRACK MICROTRON. Eric Brannen and

H. Froelich (Univ. of Western Ontario, London, Ont.). J. Appl. Phys., 32: 1179-80(June 1961).

Preliminary operation of a "racetrack" microtron is described. The microtron is designed to utilize injection at 10 to 20 kev, and have a 30 ma output of electrons at 4 to 12 Mev. The microtron is built in four sectors, with accelerating gaps that flare outward. Advantages of this type of accelerator over the conventional microtron include better beam characteristics, a smaller magnet gap, flare focusing, and release from injection energy and energy turn per gain restrictions. (T.F.H.)

21611 EVIDENCE OF PARTICLE LOSS BY SPACE CHARGE AND OF AN ANOMALY IN THE MEDIAN PLANE OF THE SATURNE SYNCHROTRON. G. Gendreau, H. Bruck, A. Gabet, M. Gouttefangeas, J. Hamelin, R. Levy-Mandel, A. Nakach, G. Rastoix, G. Rommel, R. Schoen, and R. Vienet (Commissariat à l'Énergie Atomique, [Paris]). J. phys. radium, 22: 93-7(Feb. 1961). (In French)

Measurements of the number of particles effectively present in the vacuum chamber before turning on the RF (τ_{HF}) prove that half the injected beam is lost on the back of the inflector due to interaction. The causal effect (repulsion of two bunches circulating together) is made evident from the experimental and theoretical point of view; the important perturbation on the trajectories is shown. The magnetic median plane was at first 0.5 cm too high but it is lower now that a ferromagnetic radiation shielding has been put on the top of the magnet. (auth)

21612 PROJECT OF INJECTION OF VERY HEAVY IONS IN THE 2-METER CYCLOTRON OF ORSAY. R. Basile (Faculté des Sciences de Paris, Orsay, France). J. phys. radium, 22: Suppl. to No. 2, 27A-9A(Feb. 1961). (In French)

A description is given of a project for producing highly charged ions. High Z ions are triply ionized and accelerated to several Mev. They are then injected and more thoroughly stripped at the center of a variable energy and heavy ion cyclotron under construction at Orsay. (tr-auth)

21613 RADIODETECTION AND RADIOPROTECTION AROUND THE CERN PROTON SYNCHROTRON. M. P. Guillot (CERN, Geneva). Minerva nucleare, 5: 31-7(Feb.-Mar., 1961). (In French)

The proton synchrotron of the European Center for Nuclear Researches in Geneva is briefly described, and the radiodetective and radioprotective measures adopted near this accelerator are illustrated in detail. The effectiveness of these measures is demonstrated by the values obtained for the environmental and individual doses. (auth)

21614 THE MELBOURNE UNIVERSITY VARIABLE ENERGY CYCLOTRON. D. E. Caro and J. L. Rouse (Univ. of Melbourne). Nuclear Instr. & Methods, 10: 249-58(Apr. 1961). (In English)

A description is given of a variable energy cyclotron designed primarily to produce protons with an energy in the range 2 to 12 Mev, with an energy resolution of 0.1%. (auth)

21615 PHASE CHANGES NEAR THE CYCLOTRON CENTRE. G. V. H. Wilson (Univ. of Melbourne). Nuclear Instr. & Methods, 10: 259-62(Apr. 1961). (In English)

Orbits were calculated for the first three turns of ions in the Melbourne University Variable Energy Cyclotron for a number of initial phases and several peak dee voltages for an electric field distribution which was determined from electrolytic tank measurements. The phase motion features are explained by a simple qualitative theory, which also explains the dependence of the phase changes upon electrode geometry. (auth)

21616 PRECISION INSTRUMENTATION FOR AN ELECTRON ACCELERATOR. I. T. Myers and H. V. Larson (General Electric Co., Richland, Wash.). Nuclear Instr. & Methods, 10: 281-8(Apr. 1961). (In English)

The supporting instrumentation necessary for a Van de Graaff electron accelerator is described. This includes a beam current integrator, a capacitor divider voltmeter, and an electron beam calorimeter, all with a precision of approximately ±0.05%. A cavity ion chamber for x-ray measurements, an extrapolation chamber for electron absorbed dose measurements, and an automated gold target are also included. (auth)

21617 ANALYTICAL APPROXIMATION FOR CALCULATION OF AZIMUTHALLY PERIODIC MAGNETIC FIELDS IN CIRCULAR ACCELERATORS. H. Neu and H. Werner (AEG-Forschungsinstitut, Frankfurt am Main). Nuclear Instr. & Methods, 10: 333-8(Apr. 1961). (In German)

Formulas are presented for the approximate calculation of the average field and the flutter of the magnetic field arising from two-dimensional rectangular pole configurations. These formulas are useful for design and construction of isochronous cyclotrons and FFAG-synchrotrons. In deriving the formulas the actual field is replaced by a step function and the pole surface is supposed to have a constant magnetic potential. (auth)

21618 A 20.5-Mev LINEAR PROTON ACCELERATOR. K. K. Sinel'nikov, P. M. Zeydlits, A. M. Nekrashevich, L. I. Bolotin, Ya. S. Shutske'er, B. S. Akshanov, N. E. Kovpak, K. A. Leontovich, A. I. Akhi'ezer, I. M. Lifshits, Ya. B. Faynberg, L. N. Rozentsveyg, G. Ya. Lyubarskii, M. I. Kaganov, and L. E. Pargamanik. Trudy Ses. Akad. Nauk Ukrain. S.S.R. po Mirnomu Ispol'zovan. At. Energ., 5-15(1958).

The physical substantiation of the parameter choice is presented and the design of a linear proton accelerator with a drift tube at 20.5 Mev energy is described. The main computational data of the accelerator are the following: the operational wave length is $\lambda = 215$ cm; the injection energy is 1.7 Mev; the length of the accelerator is 1,446.8 cm; the synchronous phase is 20°; the length of the first half-tube is 4.875 cm; that of the last one is 16.725 cm; the length of the first gap is 3.380 cm; that of the last one is 11.150 cm; the length of the first draft tube is 0.145 cm; that of the last one is 32.955 cm. Altogether, the number of drift tubes is 50, that of the half tubes is 2; the acceleration system begins and ends with the latter. At the entrance of every drift tube, focusing grids are fixed consisting of parallel tungsten wires of 0.07 mm thickness; their total geometric transmittance amounts to 30%. The drift tubes are installed within the resonator by means of a suspension system; the resonator is made as a 1,446.8-cm long regular 16-face prism. The resonator is fed from 20 hf generators. The Q-factor of the resonator in the loaded state is equal to 6.5×10^4 in consequence of which the hf power needed for accelerating particles to the rated energy amounts to 1.2 Mw. An electrostatic generator operating by pulses with the pulse duration of 500 μsec at about 1 ma current intensity and 1.7 mv voltage serves as proton injector. The principal circuit and the design of the individual accelerator units are presented. (auth)

21619 AN ELECTRON ACCELERATOR WITH 3.5 Mev OUTPUT ENERGY. K. D. Sinel'nikov, P. M. Zeydlits, I. A. Grisha'ev, L. Kh. Kita'evskii, A. I. Akhi'ezer, Ya. B. Faynberg, N. P. Selivanov, and N. A. Khizhnyak. Trudy Ses. Akad. Nauk Ukrain. S.S.R. po Mirnomu Ispol'zovan. At. Energ., 16-23(1958).

A linear electron accelerator with a travelling wave of

3.5 Mev energy is described. A waveguide loaded with disks is used as accelerating system. The necessary law of wave phase velocity variation is brought about by variation of the diameter of the apertures in the disks. The 280-cm long waveguide is divided into three sections. In the first section, the phase velocity is varied from 0.5 to 0.97 c; in the second and third sections it is equal to 0.98 and 0.99 c, respectively. The electron equilibrium phase increases during the acceleration process; its initial value is equal to 45° and is chosen according to the optimum capture condition. The computational value of the hf power at the accelerator input is 900 kw; the accelerator field intensity amounts hereat to 16.5 kv/cm. The accelerator output power (about 600 kw) is absorbed in a steel load with water cooling; approximately 300 kw are dissipated in the waveguide walls. An additional axisymmetrical magnetic field with an intensity up to 400 gauss is developed by solenoids for focusing the electrons along the waveguide axis. An electron gun with three electrodes serves as electron source; it operates pulsing synchronously with the magnetron generator and provides for beam of 5 to 6 mm diameter at the accelerator input. The output parameters of the accelerator measured are: the current is about 20 to 30 ma in the pulse of 2 μsec duration, the average current is about 20 to 30 μa; the beam diameter is 3 to 4 mm with the divergence angle of 7×10^{-4} to 3×10^{-3} radian; the energy beam half-width is about 8%. (auth)

21620 RADIATION LOSS IN THE FFAG ACCELERATOR. Jochen Biersack (Hahn-Meitner-Institut für Kernforschung, Berlin-Wannsee, Ger.). Z. angew. Phys., 13: 223-4(May 1961). (In German)

The radiation output of a fast particle in a magnetic field was calculated by a simple method. The energy loss per circuit was specifically given for a particle in the FFAG accelerator. (tr-auth)

21621 TRANSPARENT CONDUCTIVE COATINGS FOR BETATRON TUBES. Václav Matějka. p.164-71 of "Sborník Prací Elektrovakuoveho Oboru. č. 1." Prague, Tesla Roznov State Inst. of Research in Vacuum Electronic Equipment, 1958. (In Czech)

A report is given of the technology and properties of transparent conductive coatings, such as are used on the interior surfaces of the vacuum chambers of experimental betatrons. (auth)

21622 LINEAR ION ACCELERATOR. J. Pottier (to C. E. A.). Belgian Patent 578,103. May 15, 1959.

The proposed design is based on the linear resonance accelerator of Ising and Widerŏe having drift tubes connected to a high frequency voltage supply; however, in order to reduce Joule-and-radiation losses, the drift tubes are enclosed in a resonant cavity; the resonant mode can be H_{111} or H_{211} and the strips which support the drift tubes are connected to the cavity along the line of maximum voltage. Smaller sizes than in conventional equipment, approximately 20 inches in diameter, are possible, and the frequency is of the order of 50 MHz which is very convenient for work with heavy ions. (EURATOM)

21623 ION SOURCES. Siegfried Klein (to Commissariat à l'Energie Atomique). Canadian Patent 618,317. Apr. 11, 1961.

A chamber for ionizing gases or vapors to form a beam of ionized particles intended to be fed to a particle accelerator with a high ionic yield (averaging some 10 ma for a high-frequency power of approximately 75 watts) is described. The ion source consists of means for applying a high direct potential difference between the ends of the tube, the tube having, near one end, an enlarged portion in the form of a flat bulb extending transversely to the direction of the tube. There are pumping means for exhausting the tube, and means for feeding the other end of the tube with a gaseous substance to be ionized. There is a high frequency current source and means forming a resonating cavity at least a portion of which surrounds the bulb, the cavity being coupled with the source to be energized by it and being arranged to form a zone of concentrated electric field including, and substantially limited to, the volume of the bulb. The ion source also includes a capacitive coupling between the high-frequency current source and the resonating cavity and a grounded shield casing surrounding the last mentioned source. (N.W.R.)

Plasma Physics and Thermonuclear Processes

21624 (AFOSR-473) IONIZATION IN AN ELECTRODELESS DISCHARGE. Richard P. Treat (Plasmadyne Corp., Santa Ana, Calif.). Mar. 15, 1961. Contract AF49(638)-655. 65p. (TN-031-655)

An analytical study was made of ionization occurring in a weakly pre-ionized molecular hydrogen gas. The configuration studied consists of a long, cylindrical gas column subjected to a strong, fast-rising, axial magnetic field which is initially zero. The investigation showed that in practice it is possible to obtain a large number of ionization collisions in a time t_m during which the plasma mass motion and the magnetic field are negligible. For this time interval, if electron losses are neglected, the increase in ionization fraction depends only on the voltage induced around the discharge tube and on the ratio of the circumference of the tube to the electron mean-free-path. Quantitative order-of-magnitude results are given for the relation. For a fixed voltage around the discharge tube, maximum ionization during the mass motion time t_m occurs if the energy gained by an electron in a free path is about equal to the threshold energy for ionization. (auth)

21625 (AFOSR-665) THE EFFECT OF COULOMB SCATTERING ON TWO-STREAM INSTABILITIES IN A PLASMA. D. A. Tidman (Maryland. Univ., College Park). Apr. 1961. Contract AF49(638)-401. 36p. (BN-242)

A study was made of the effect of a small amount of two-body scattering on the two-stream instability that occurs in a plasma of contrastreaming electrons and ions. This is done by assuming the electron-ion collision frequency is small and making a perturbation expansion in this quantity. The Fokker-Planck scattering formula for the coulomb interaction was used. It was found that as the ordered streaming energy of the electrons is thermalized, enhanced Landau damping competes with the growth of the instability. (auth)

21626 (ARL-71) VELOCITY DEPENDENT CORRELATIONS IN THE STATISTICAL DISTRIBUTION OF THE ELECTRIC MICROFIELD IN A PLASMA. Technical Note No. 3. Amiran Ron and G. Kalman (Israel Inst. of Tech., Haifa). Mar. 25, 1961. Contract AF61(052)-177. 29p.

The polarization of the plasma particles in the neighborhood of a moving ion depends on the ion velocity. This affects the distribution of the stochastic field acting on the ion. Correction to the Holtsmark field particle correlation including this dynamic effect was calculated up to the order e^2. Results indicated a shift toward smaller fields, anisotropy, and velocity dependence, which was not equal to the zero velocity effect even on the average. (auth)

21627 (ARL-72) INTERACTION OF A TEST PARTICLE WITH A PLASMA. PART II. ENERGY LOSS OF THE TEST PARTICLE. Technical Note No. 2. G. Kalman and Amiran Ron (Israel Inst. of Tech., Haifa). Mar. 20, 1961. Contract AF61(052)-177. 69p.

A perturbation analysis of the energy loss suffered by a test particle traveling through a plasma is considered. The action of the system on the particle is described as a combined result due to the polarization of the medium and to the correlated fluctuations of the electric microfield. The calculation was extended up to the order of e^6. Higher order effects appeared through time correlations of the electric field and its derivatives to points of the unperturbed system. The possibility of a systematic extension to higher orders is indicated. (auth)

21628 (ARL-TN-60-173) OHMIC HEATING OF FULLY IONIZED PLASMAS; EXPERIMENTAL PART. W. Kluge and K. H. Hocker (Stuttgart. Technische Hochschule). Dec. 1960. Contract AF-61(052)-199. 9p. (AD-248320).

Experiments on the ohmic heating of fully ionized plasmas were carried out using a linear whirl-stabilized high current discharge operated chiefly in nitrogen. The length of the discharge column was about 50 mm and its diameter varied from 2 to 3 mm. A small condensor bank was then discharged over this stationary plasma column. A short-time rise of the current to 10^5 amp occurred. The behavior of the plasma column during this pulse discharge was ascertained by means of image converter photographs with effective exposure times of approximately 10^{-7} sec. From the experimental data, including tentative determination of the discharge diameter from image converter photographs, estimates of temperatures in the range of 6×10^5 to 10^6 K were made. (auth)

21629 (CLM-R-1) MAGENETIC FIELD PERTURBATIONS INA TOROIDAL METAL DISCHARGE TUBE. C. F. Vance (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Oxfordshire, England). Jan. 1961. 27p.

Any externally produced changes in the magnetic field between a discharge and a metal torus must enter through slits in the torus wall. These slits also admit stray flux due to currents flowing along flanges surmounting the slits. The amplitudes of resulting field perturbations at the discharge surface are expressed as functions of the ratio c/λ), where c is the clearance between discharge and torus (assumed much greater than the slit width) and λ is the wavelength measured parallel to the slit. A rectangular approximation was used to avoid the complications of curved geometry. Appendices discuss some of the errors and some unsolved problems in toroidal geometry are posed. (auth)

21630 (INSJ-37) ON A MAGNETIC PICK-UP PROBE FOR CHARGED PARTICLE BEAMS. Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Apr. 1, 1961. 26p. (TH-9)

A new method for the detection of an electron or ion beam without intercepting it was invented and successfully applied to a linac beam. The method uses a magnetic core and an integrator. The beam through the opening of the core makes magnetic flux in the core. The pick-up coil wound around the core detects the flux change, and the output of the coil is integrated. The output of the integrator is proportional to the instantaneous beam current. Several volts may easily be obtained with a ferrite core for a 100 ma beam. This method can be also applied to the synchrotron to measure the number of circulating electrons. A comparison is made between this method and the conventional electrical pick-up electrode method. The sensitivity of this method is comparable to or higher than the electrical one to measure the total current but much lower to detect the location of a beam. This method is independent of the charge scattered on the probe, while the electrical one is made ineffective by the scattered charge in some cases. (auth)

21631 (ORO-407) PRINCIPLES OF PLASMA DYNAMICS. Behram Kurşunoğlu (Miami. Univ., Coral Gables, Fla.). May 15, 1961. Contract AT(40-1)-2761. 207p.

An extensive mathematical treatment of plasma physics is presented. Some statistical concepts used in plasma physics are discussed. Plasma kinetics and stochastic processes are also discussed. Relativistic plasma and plasma radiations are considered. A quantum description of plasma is presented. (D.L.C.)

21632 (PAN-210/IX) BEHAVIOUR OF PLASMA IN ROTATING MAGNETIC FIELD. A. Legatowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1961. 18p.

The problem of the behavior of plasma in a rotating magnetic field is considered. The motion of the charged particle is investigated. The solution of the non-relativistic equation of motion is given as well as the condition for the particle moving within limited space. The energy achieved by the particle is estimated. The motion of plasma is also considered its own electromagnetic field taken into account. It is shown that the field concerned causes neither a durable change in plasma density nor a charge separation. Oscillations of several frequencies appear in the plasma. Certain assumptions accepted it is possible to obtain resonance within ion component of plasma. (auth)

21633 (PAN-215) THE THEORY OF THE MAGNETOHYDRODYNAMIC GENERATOR WITH CONSTANT AREA. P. J. Nowacki (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1961. 18p.

Starting from the basic equations of the Magnetohydrodynamic Generator (1 ÷ 7) under assumption of undirectional flow the case of constant area of the generating section has been dealt with in detail. The pressure-velocity relation was expressed by an equation, and the velocity-distance relation is expressed by other equations. Expressions for the current and electric power output were developed. Finally design considerations for constant area generators are given. A new approximate formula for the internal thermodynamic efficiency η_i was developed. The solution of the velocity-distance relation, and the proof for the minimum pressure ratio for the choking condition $M_2 = 1$, where M_2 is the Mach number at output are included. (auth)

21634 (TID-11746) VISIT OF U. S. CONTROLLED THERMONUCLEAR RESEARCH TEAM TO U.S.S.R., JULY 1960. P. R. Bell, Arthur E. Ruark, and C. M. Van Atta (Atomic Energy Commission, Washington, D. C.). May 1961. 86p.

A summary of observations at USSR research institutes by members of the U. S. delegation on controlled thermonuclear research is presented. The research institutes visited include The I. V. Kurchatov Institute of Atomic Energy, Moscow, The Physico-Technical Institute of the Academy of Sciences, Leningrad, The Scientific Research Institute of Electro-physical Apparatus, Leningrad, The Institute of Electronic Physics of the Academy of Sciences of the Georgian SSR, Sukhumi, and The Physico-Technical Institute of the Academy of Sciences of the Ukrainian SSR, Kharkov. (J.R.D.)

21635 (TID-12757) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 5, December 1,

1960–February 28, 1961. (Stanford Univ., Calif. Microwave Lab.). Apr. 1961. Contract AT(04-3)-326. 18p. (ML-811)

Low-frequency fluctuation measurements were made for constricted, gridded, and uniform plasma tubes. Graphical representations are given showing frequency spectra, relations between peaks in the spectra, and probe characteristics of the tubes. An experimental discharge tube for studying microwave oscillations was built and preliminary measurements were begun. (B.O.G.)

21636 (NP-tr-525) PROBLEMS OF FLOWING AROUND IN MAGNETIC HYDRODYNAMICS. M. D. Ladyzhenskii (Ladyzhenskiy). Translated from Priklad. Mat. i Mekhan., 23: 292-8(1959). 14p.

The problem of a body from inside of which the magnetic field is excited by the stream of electroconductive fluid is studied, and the case for the infinitely large Reynolds' magnetic number is given. The values of Reynolds' magnetic number when the magnetic forces are acting on the flow around such bodies are analogous to viscous friction and profile resistance, which can be called, respectively, the force of magnetic friction and the force of magnetic profile resistance. The case in which the magnetic and electric field is excited from inside the body is also examined. (J.R.D.)

21637 STABILITY OF A PLASMA PINCHED BY AN ELECTROMAGNETIC FIELD. M. Micu (Institutul de Fizică Atomică, Academia R.P.R., Bucharest). Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz., Studii cercetări fiz., 11: 827-36(1960). (In Rumanian)

A plasma contained in a resonant cavity is analyzed with respect to its stability. A cylindrical resonant cavity is studied with the following electromagnetic field configurations: the field of the cavity alone, the field of the cavity plus a constant longitudinal field, and the field of the cavity plus the field produced by an electric discharge in the plasma. It was found that in the presence of the electromagnetic field of the cavity, perturbations which were stable in its absence become unstable and vice versa. Mathematically in the case of the three configurations the stability of the perturbations is expressed by the stability of the solutions of an equation of the Mathieu or Hill type. (tr-auth)

21638 CONTROLLED THERMONUCLEAR REACTIONS. [PART] I. L. Th. M. Ornstein. Atoomenergie Haar Toepassingen, 3: 57-60(Apr. 1961). (In Dutch)

The principles of thermonuclear investigation are given, and non-controlled systems are considered. (tr-auth)

21639 WAVE SURFACES IN MAGNETOHYDRODYNAMICS. [PART] II. Cataldo Agostinelli (Atti acad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 29: 1-7(July-Aug. 1960). (In Italian)

The differential equation of the wave surface of a compressible fluid of infinite electrical conductivity was derived explicitly in finite terms for the case in which the Alfven wave is constant in magnitude and direction and the velocity of sound is a pure constant. (J.S.R.)

21640 A METHOD OF DETERMINING THE CONCENTRATION OF FREE ELECTRONS IN A PLASMA. I. A. Vasil'eva, V. L. Granovskii, and V. I. Savoskin. Byull. Izobretenii, No. 9, 49(1960).

A method of determining the concentration of free electrons in a plasma in the presence of a magnetic field is described. It increases the resolution capability by a flat-polarized beam of infrared radiation passing through the plasma. The concentration of free electrons is determined by the variation of the beam's intensity, or from its angle of deflection. (auth)

21641 GENERAL EXPRESSION OF THE ELECTRIC CONDUCTIVITY TENSOR OF A PLASMA PLUNGED IN A CONSTANT MAGNETIC FIELD. Daniel Quemada (Laboratoire des Hautes Énergies, Service de Physique des Plasmas, B. P. No. 2, Orsay, France). Compt. rend., 252: 3027-9(May 15, 1961). (In French)

By using macroscopic equations, an expression for the conductivity of a plasma submitted to a magnetic field oriented in any fashion with respect to the wave vector k is obtained. In the limits of validity of the hypothesis of isotropic pressure and of adiabaticity, this expression takes account of the temperatures of the two types of particles and of collisions. The results are compared with other recent treatments. (tr-auth)

21642 PLASMA OSCILLATIONS AND DYNAMICAL FRICTION. A. Hruška (Astronomical Inst., Czechoslovak Academy of Sciences. Prague). Czechoslov. J. Phys., B11: 268-71(1961). (In English)

The force F of mutual interaction of two species of charged particles in relative motion with velocity U is, for U higher than the mean thermal velocities of particles, a decreasing function of U. This property of F(U) can give rise to the excitation of electrostatic oscillations. (auth)

21643 THE BROADENING OF THE HYDROGEN LINES IN THE PLASMA OF AN ARC AND OF A SHOCK TUBE. V. F. Kitaeva and N. N. Sobolev (Lebedev Inst. of Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 1091-4(Apr. 11, 1961). (In Russian)

The displacements of the H_α and H_β lines were observed on a high-resolution (~1 A) spectrograph in a carbon arc in a shock wave and were compared with the theoretical values predicted from the theory of Griem, Kolb and Shen. The good agreement between the theoretical and experimental lines showed that the concentration of charged particles could be determined from the half-width of the H_β line at $N_i = 2 \times 10^{15}$ to 10^{17}, and from the half-width of the H_α line at $N_i > 3 \times 10^{16}$ with the use of theoretical comparison curves relating the half-width to the concentration of charged particles. The theory predicts that the contour of the H_β line should be symmetrical but the experiment shows that the violet and red maxima of the H_β line are unsymmetrical both with respect to position around the center of the line and with respect to intensity. The magnitude of the intensity gap at the center of the experimental ΔH_β contour is greater than theoretical for wide lines ($\delta\lambda_{H\beta} > 40A$) and is less than theoretical for narrower lines. The theory can be improved by summing up the integrals at a radius greater than the Debye radius and by taking into account the Doppler effect. (TTT)

21644 A NEW MAGNETIC CONTAINER FOR CHARGED PARTICLES–THE "ROTATRON." Giancarlo Sacerdoti (Laboratorio de Frascati, Italy). Elettrotecnica, 47: 654-8(Sept. 1960). (In Italian)

A magnetic container design for ions is described. The motion of a charged particle can be studied with a simplifying hypothesis (zero electric field). It is not otherwise possible to do the calculations on thermal diffusion of ions which permit study of the real potential for design of apparatus for controlled hydrogen fusion. One can now deduce the relations between magnetic energy and the kinetic energy of particles and the time of containment. (tr-auth)

21645 SCATTERING OF MICROWAVES FROM A CYLINDRICAL PLASMA IN THE BORN APPROXIMATION. [PART] I. Yukio Midzuno (Tokyo Univ.). J. Phys. Soc. Japan, 16: 971-80(May 1961).

The scattering of a plane microwave incident upon a cylindrically symmetric non-uniform plasma is treated in the Born approximation. When the electric vector is parallel to the axis of the cylinder, the angular distribution function of the cylindrical wave scattered from a cylindrical collisionless plasma is given by $f(\theta) = \sqrt{(\pi/2)}e(^3/_4)\pi j \int_0^\infty k^2\eta(\rho')J_0[2k\rho' \sin(\theta/2)]\rho' d\rho'$. Here θ is the scattering angle, $\eta = (\omega_p/\omega)^2$ with the plasma frequency ω_p, and the incident wave is assumed to be proportional to $e^{j(\omega t - kx)}$. The angular distributions for other cases, e.g., waves with the electric vector perpendicular to the axis and/or plasmas with collision loss in a magnetic field, are simply related to $f(\theta)$. For some special density distributions such as that of J_0-type, the integration in $f(\theta)$ can be performed analytically. Finally the same formulas are rederived by summing the radiations from electrons which are forced to oscillate by the incident wave. (auth)

21646 SOME BOUNDARY VALUE PROBLEMS INVOLVING PLASMA MEDIA. James R. Wait. J. Research Natl. Bur. Standards, 65B, 137-50(Apr.-June 1961).

A plasma consisting of a neutral mixture of electrons, ions and molecules, in the presence of a constant magnetic field H_0, possesses a tensorial dielectric constant. Exact solutions of boundary value problems involving such media are obtained for two-dimensional configurations. Explicit results are given for the reflection coefficients of electromagnetic waves from stratified plasma in planar and cylindrical geometry. (auth)

21647 RATES OF RECOMBINATION IN HYDROGENIC PLASMAS. (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Nature, 190: 902-3 (June 3, 1961).

The possibility of three-body recombination into an excited state followed by spontaneous radiative decay an effective recombination mechanism is investigated. Computations are made of the rate at which the ground-states of hydrogen atoms and of hydrogen-like ions (B,V,Z = 5) are populated as a result of the following processes among the first 20 quantum states of the atom, the continuum of free electrons, and the corresponding bare nuclei: collision ionization, three-body recombination, collisional transitions between bound states, radiative recombination, and spontaneous radiative transitions. The results are graphically presented in terms of a correction factor which is the amount by which the ground-state radiative recombination rate has to be multiplied to give the computed rate of populating the ground-state. The departures of the populations of the excited states of hydrogen from their Saha values is illustrated in a recombining plasma at an electron temperature $kT_e = 1$ ev. The rate at which the ion population decayed is about ten times greater than the radiative recombination rate for the hydrogen plasma of zeta. (N.W.R.)

21648 STATISTICAL THERMODYNAMICS OF PLASMAS. H. S. Green (Univ. of Adelaide). Nuclear Fusion, 1: No. 2, 69-77(Mar. 1961). (In English)

A systematic method for the computation, with arbitrary accuracy, of the thermodynamic functions of a gaseous plasma is developed. The theory of the grand partition function is used to derive a set of exact integral equations, which determine the electronic and ionic distribution functions. An approximate solution of these equations yields results similar to those of the Debye-Hueckel theory of electrolytes. More exact solutions are developed and used to compute the equation of state and other thermodynamic functions for plasmas. (auth)

21649 A SIMPLIFIED ANALYSIS OF THE DYNAMICS OF PLASMA GUNS. J. G. Linhart (Association Euratom-Comitato Nazionale per le Richerche Nucleari, Frascati, Italy). Nuclear Fusion, 1: No. 2, 78-81(Mar. 1961). (In English)

The acceleration of a cylindrical layer of plasma by an azimuthal magnetic field is considered. This is a process similar to the $B_\phi I_z$ pinch. The magnetic field is generated by a current drawn from a condenser. The system can be represented by an LC circuit in which the value of the inductance changes, owing to the movement of the plasma conductor. A simple but approximate description of the acceleration of the plasma can then be derived using the adiabatic theorem for oscillators together with the law of conservation of energy. The resulting approximate solutions are compared with numerical solutions of the appropriate differential equations. The approximate solutions are also applied to a rail-type of plasma gun. (auth)

21650 NONLINEAR OSCILLATIONS OF RAREFIED PLASMA. A. A. Vedenov, E. P. Velikhov, and R. Z. Sagdeev (Kurchatov Inst. of Atomic Energy, Academy of Sciences, Moscow). Nuclear Fusion, 1: No. 2, 82-100 (Mar. 1961). (In Russian)

Studies relating to the theory of nonlinear motions of rarefied plasmas are reviewed. The evolution in time of a perturbation of finite amplitude is studied, considering the effects of nonlinear increases in wave steepness, dispersion, absorption, and instability. For cases in which the absorption and instability are negligible, approximations to the nonlinear motions may be obtained by applying the corresponding linear dispersion law. Certain nonstationary nonlinear motions that permit exact mathematical solutions are discussed. The possibility of the formation of a multi-component current and of stationary waves is noted. A quasi-linear approximation method is developed for absorption of waves in rarefied plasmas. The absorption of Langmuir electronic oscillations and of the transversely polarized waves that propagate along the magnetic field are shown as examples. Instabilities of nonlinear systems are described, including multi-component motion instabilities and instabilities of stationary waves of large amplitude. (T.F.H.)

21651 FLUCTUATIONS OF A PLASMA (1). Norman Rostoker (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Fusion, 1: No. 2, 101-20 (Mar. 1961). (In English)

At time t the state of a fully ionized plasma is represented by a point X in the phase space of all the particles. The product $D_s dX dX' \ldots dX^{(s)}$ is defined as the joint probability that at time t the system will be in (X,dX), at time t' in (X', dX'), etc. A systematic procedure is developed for calculating any desired moment of D_s as an expansion in the discreteness parameters. Spectral densities and autocorrelation functions can thus be obtained without any "Stosszahlansatz" or Markoffian assumption. A treatment of a plasma in thermal equilibrium is carried out. A large class of non-equilibrium states may exist in a hot plasma for sufficient time to be considered stationary. Fluctuations are calculated for the class of spatially homogeneous states of an infinite plasma. Thermal equilibrium relationships such as Kirchhoff's radiation law and the fluctuation-dissipation theorem survive. The degree of excitation of the collective modes such as plasma waves, ion oscillations, etc. are calculated. For distribution functions that approach instability as some parameter is varied, the energy for some modes becomes very large and ultimately becomes infinite as instability is approached. (auth)

21652 EQUILIBRIUM AND STABILITY OF AN AXIALLY SYMMETRIC PLASMA WITH ANISOTROPIC PRESSURE. Claude Mercier and Michel Cotsaftis (Euratom—Commissariat à l'Energie Atomique, Fontenay-aux-Roses, Seine, France). Nuclear Fusion, 1: No. 2, 121-4(Mar. 1961). (In French)

The stability of axially symmetric plasma with anisotropic pressure is studied. The necessary condition for stability, previously found for a scalar pressure, is generalized; two additional conditions appear that are always satisfied for a scalar pressure. (auth)

21653 VOLTAGE CHARACTERISTICS OF A ROTATING PLASMA. B. Lehnert (Royal Inst. of Tech., Stockholm). Nuclear Fusion, 1: No. 2, 125-30(Mar. 1961). (In English)

The balance of forces is investigated for a rotating plasma contained in a long cylindrical vessel and placed in an axial magnetic field. A relation is deduced between the voltage which arises in a radial direction in the plasma and the electric charge being transmitted through the system from an external source. It is found that the equivalent capacity, which describes the electrical behavior of the plasma, depends upon the transmitted charge and upon the constitution of the vessel wall. An explanation is suggested for the voltage limiting effect earlier observed in the Ixion device. (auth)

21654 PLASMA ACCUMULATION IN A DEVICE FED BY ENERGETIC-ION TRAPPING. R. J. Mackin, Jr. (Oak Ridge National Lab., Tenn.). Nuclear Fusion, 1: No. 2, 131-8(Mar. 1961). (In English)

Plasma accumulation (without energy losses) in a device in which energetic ions are injected and trapped is discussed. A previous general steady-state theory for devices, such as the OGRA device, where trapping is initiated by interactions with background gas is noted. For such devices there is usually a critical input current or critical plasma density (a function of input current) above which plasma density builds up to a value limited by Coulomb scattering losses. For a specific regime of operation (600 kev hydrogen molecular ion injection and dissociation, highly efficient ion-pumping action of the trapped plasma), simple approximate formulas are derived that describe the critical current or density for plasma build-up. Second-approximation formulas are derived that describe with about 10% error the overlapping segments of the density versus current curve for a broad range of parameters. The analysis is applied to a system in which the initial trapping is accomplished by a Luce carbon arc, e.g., DCX-2. It is found that if the arc is turned off slowly or if an arc of lower density is used, then the critical current for plasma build-up with arc is nearly an order of magnitude less than previously estimated; and that the critical arc density, below which plasma build-up occurs after the arc is removed, is sufficiently low that energy losses to fixed-temperature arc electrons are not significant. The time-dependence of plasma build-up, certain aspects of the impurity problem, and electron heating effects are also considered. Numerical examples are given for OGRA and DCX-2. (auth)

21655 THE DAMPING OF RAYLEIGH-TAYLOR INSTABILITIES IN A THETATRON DISCHARGE. H. A. B. Bodin, A. A. Newton, and N. J. Peacock (A.W.R.E., Aldermaston, Berks, Eng.). Nuclear Fusion, 1: No. 2, 139-43 (Mar. 1961). (In English)

A high-speed framing camera is used to photograph deuterium and helium discharges in which flute instabilities are driven by the inertial force of a radial acceleration. The wavelength of the instability increases with decreasing initial pressure, suggesting the damping effect of viscosity; in some cases this damping apparently prevents the growth of flutes entirely. A simple theory of viscous damping is in qualitative agreement with the observations. An instability due to the radial acceleration accompanying a rotation of the plasma appears at about peak field. (auth)

21656 GAS LAW AND CONDUCTIVITY OF A COLLISION-FREE PLASMA. O. Buneman (Peterhouse, Cambridge, Eng. and Stanford Electronics Lab., Calif.). Phys. Fluids, 4: 669-80(June 1961).

The moment method is used to derive a form of two-component magneto-gas-dynamics for a collision-free plasma. Closure of the moment equations is achieved by ignoring variations of fourth moments of the peculiar velocities for each component. This provides a "fully adiabatic gas law" that represents a generalization of the single or double adiabatic laws in that it predicts the gyrations of the pressure tensor, as well as the principal pressures. The currents that small perturbing electric fields cause to flow in each species in accordance with its own adiabatic gas dynamics are calculated. A complex conductivity tensor is thus deduced. This tensor is compared with that resulting from rigorous kinetic theory (without closure), for the case of a uniform plasma. It is found to be identical with the "warm plasma approximation" which takes temperature into account to first order. Hence this two-component fully adiabatic theory describes supersonic phenomena quite well, but is inadequate for the phenomenon of Landau damping. This type of theory could serve to provide pessimistic stability tests for nonuniform confined plasmas. (auth)

21657 EXACT RELATIVISTIC FOKKER-PLANCK COEFFICIENTS FOR PLASMA AND RADIATION: III. Albert Simon (Oak Ridge National Lab., Tenn.). Phys. Fluids, 4: 691-5(June 1961).

Exact relativistic Fokker-Planck coefficients are derived for the case of a plasma composed of electrons and infinite mass ions. These results are generalized to the case of an arbitrary number of finite-mass ion species. (auth)

21658 DYNAMICS OF IONIZED GASES. Thomas H. Dupree (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 4: 696-702(June 1961).

Ionized gas dynamics is discussed in terms of two coupled equations for the one- and two-particle distribution functions. The equations were obtained previously by multiple integration of the Liouville equation and a formal expansion in the specific volume. The two-particle equation is solved for a multicomponent plasma in terms of two operators that depend on the one-particle functions. It is shown that these operators have a simple interpretation and lend an easy insight into the correlation mechanism. If the time dependence of the one-particle functions that occur in the operators is neglected, the operators can be obtained explicitly. This procedure is shown to be valid for plasmas with "smooth" velocity distributions and no large inhomogeneities. When velocity instabilities exist, the correlation function is subject to growing oscillation. The ultimate effect of this instability is not clear. (auth)

21659 RADIO EMISSION BY PLASMA OSCILLATIONS IN NONUNIFORM PLASMAS. D. A. Tidman and George H. Weiss (Univ. of Maryland, College Park). Phys. Fluids, 4: 703-10(June 1961).

The electromagnetic (radio) wave emission when a field of longitudinal plasma oscillations is incident on a localized density fluctuation in a plasma is calculated. Use is made

of the collisionless Boltzmann equation to describe the electron component of the plasma and compare the results with those previously obtained using the moment equations for this problem. (auth)

21660 EFFECTS OF IONIZATION AND MAGNETIC INITIAL CONDITIONS ON A MAGNETICALLY COMPRESSED PLASMA (SCYLLA). E. M. Little, W. E. Quinn, and F. L. Ribe (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 711-30(June 1961).

The effects of strong preionization and the application of steady bias magnetic fields on the operation of the magnetic compression device Scylla are studied. It is shown that both strong preionization and a bias field B_0 antiparallel to the main compression field B_z are necessary to produce d-d neutrons during the first half-cycle of B_z. Other aspects of the plasma activity are also shown to depend strongly upon the sign of B_0. Application of bias fields with weak preionization leads to production of hard x rays, which occur on the half-cycle of the discharge preceeding that of neutron emission. When hard x rays are produced the plasma is not hydromagnetic. The hard x rays are extinguished when there is strong preionization, leading to a hydromagnetic plasma. In the case of the hydromagnetic plasma it is concluded that the antiparallel B_0 is most effective early in a given half-cycle and affects the plasma primarily during its preheating, ionization phase, rather than during the later adiabatic-compression phase. An interpretation is given in terms of a plasma sheath that has special properties when it separates magnetic fields of opposite signs. (auth)

21661 SELF-CONSISTENT REVERSED FIELD SHEATH. R. C. Mjolsness, F. L. Ribe, and W. B. Riesenfeld (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 730-5(June 1961).

An analytic solution is obtained for the structure of a prototype reversed field sheath. The configuration is a region of uniform (direct) magnetic field, separated from a second region of uniform (reversed) field of equal magnitude but opposite sign by a current sheath of finite width composed of zero temperature plasma. Growth rates of certain instabilities of the system are calculated. It is found that the modes considered do not grow as rapidly as the plasma frequency, but the growth rates may still be quite large. Finally, a qualitative discussion is given of the results to be expected when the reversed field is opposed by a direct field of larger magnitude. (auth)

21662 INFLUENCE OF COULOMB INTERACTIONS ON THE CYCLOTRON RADIATION OF ELECTRONS MOVING ON A SINGLE ORBIT. Ryszard Gajewski (Case Inst. of Tech., Cleveland) and Jay L. Hirshfield. Phys. Fluids, 4: 736-9(June 1961).

The incoherent cyclotron radiation at a harmonic of the cyclotron frequency from electrons moving on a single orbit is shown to be reduced, as a result of the nearest-neighbor Coulomb interactions whenever the electron's random thermal energy is less than the Coulomb energy. The conditions under which this theory is valid are compared with those prevailing in the Astron E layer. (auth)

21663 RADIATION FIELD AND Q OF A RESONANT CYLINDRICAL PLASMA COLUMN. W. D. Hershberger (Univ. ofCalifornia, Los Angeles). Phys. Fluids, 4: 740-2 (June 1961).

A cylindrical plasma column displays a series of resonant responses when it is excited by an electromagnetic wave whose electric field and direction of propagation are both perpendicular to the axis of the column. In the principal member of the mode spectrum, the electrons are assumed to move in phase in a direction transverse to the axis of the column. The diameter of the column, 2a, is small compared to wavelength. For the transverse electronic motion described, an expression for the vector potential in the region about the column is derived and thence the electromagnetic field components. The radiation field components E_ϕ and H_z vary as $\rho^{-\frac{1}{2}}$, where ρ is the distance from the column. The effect of radiation damping is calculated by deriving an expression for the selectivity factor when the radius a is much less than a wavelength. (auth)

21664 GENERALIZATIONS OF THE SAHA EQUATION. Edmond M. Dewan (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Fluids, 4: 759-64(June 1961).

The Saha equation, which relates temperatures to ion densities, is sometimes used under circumstances that do not justify the assumptions of thermodynamic equilibrium upon which it is based. Astronomers, for example, make generalizations of this equation, but they assume thermodynamic equilibrium energy distributions for the particles and the radiation field even though these may be at different temperatures. It is important to know how the nonequilibrium steady-state energy distributions affect the ionization densities. A general expression relating ion densities to the radiation and particle energy distributions is obtained. This equation reduces to Saha's equation in the limit of thermal equilibrium. Under certain conditions results are expected that differ enormously from those predicted by the Saha equation. (auth)

21665 PLASMA DENSITY FLUCTUATIONS IN A MAGNETIC FIELD. E. E. Salpeter (Cornell Univ., Ithaca, N. Y. and Univ. of Sydney). Phys. Rev., 122: 1663-74(June 15, 1961).

Sinusoidal electron charge density fluctuations with propagation vector κ are considered for a fully ionized gas in complete thermodynamic equilibrium in a constant magnetic field. Let α and ϵ be the ratio of the Debye length and of an electron gyroradius, respectively, to the wavelength κ^{-1}. A general formula is derived for the frequency spectrum of these fluctuations for arbitrary values of α, ϵ, and the angle $(\phi - \frac{1}{2}\pi)$ between κ and the magnetic field. A very small electron-ion mass ratio m/M is assumed. For large values of ϵ and α most of the intensity occurs at small frequencies. If $\sin\phi \gg (m/M)^{\frac{1}{4}}\epsilon$, the main spectrum is continuous as in the absence of a magnetic field. If $(m/M)^{\frac{1}{4}} \ll \sin\phi \ll (m/M)^{\frac{1}{4}}\epsilon$, the spectrum consists of lines with spacing about the ion gyrofrequency. If $\sin\phi \ll (m/M)^{\frac{1}{4}}$, the spectrum consists mainly of a line at zero frequency. Weaker spectral lines are obtained that correspond to plasma oscillations. The existence of "frequency gaps" is confirmed for small ϕ, and the intensities of the various components are evaluated. For small ϕ, spectral line is obtained at a "resonance" frequency intermediate between the electron and ion gyrofrequency. (auth)

21666 ELECTROSTATIC POTENTIAL GRADIENTS IN A PENNING DISCHARGE. F. Salz, R. G. Meyerand, Jr., E. C. Lary, and A. P. Walch (United Aircraft Corp., East Hartford, Conn.). Phys. Rev. Letters, 6: 523-5(May 15, 1961).

The Penning or oscillating-electron discharge is shown to produce non-thermal-equilibrium ion and electron velocity distributions in a plasma. Potential gradients with dimensions greater than a Debye wavelength result from these velocity distributions. The gradients are generated and maintained by the net volume production of ion-electron

pairs. A Penning discharge apparatus is described, by means of which the potential distribution over the length of the plasma can be measured. A mathematical method is given for calculating the self-consistent potential to any desired accuracy, under the assumption of equal electron and ion densities. (T.F.H.)

21667 EXPERIMENTS ON THE ENERGY BALANCE AND CONFINEMENT OF A MAGNETIZED PLASMA. J. Bergström, S. Holmberg, and B. Lehnert (Royal Inst. of Tech., Stockholm). Phys. Rev. Letters, 6: 525-7 (May 15, 1961).

The confinement and energy balance of rotating plasmas are studied by means of a device whose configurations may be changed to resemble the homopolar, Ixion, and current loop types of plasma generators. The effects of particle losses along the magnetic field lines to a nonconducting wall are examined. For the three configurations studied, the voltage and current characteristics, light intensities, gas production, and wall deterioration effects are determined using H and N gas. The plasma contains a considerable amount of energy for as long as 0.7 msec. (T.F.H.)

21668 PLASMA DIFFUSION IN SYSTEMS WITH PARTICLE LOSSES. N. J. Phillips (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 965-70(May 1, 1961).

In some experimental fusion devices, plasma is confined by a magnetic field and steadily lost out of the ends of a magnetic bottle. When the scattering rate of particles is high, field diffusion and particle loss can be considered from a macroscopic point of view. The formation of a steady-state sheath into which particles diffuse only to be lost along the lines of force is noted. The theory is developed to the extent that the original approximations are evident, though the theory remains essentially phenomenological. It is shown that a steady-state plasma sheath is formed whose thickness depends on the plasma resistivity, sound speed, and length. The sheath moves into the plasma with a speed which depends on the same parameters. (auth)

21669 OSCILLATIONS OF A PLASMA IN A STATIC MAGNETIC FIELD. N. Anderson (Trinity Coll., Cambridge, Eng.). Proc. Phys. Soc. (London), 77: 971-9(May 1, 1961).

The propagation of waves through an infinite homogeneous plasma permeated by a static magnetic field is considered. The Boltzmann equation is linearized by the usual perturbation method and the distribution function obtained in the form of an integral. From the expression for the distribution function the current density is calculated, which on insertion into Maxwell's equations gives the dielectric tensor relating the components of the displacement to those of the electric field. Explicit expressions are given for the components of the dielectric tensor in the particular case in which the mean Larmor radius of the particles is considerably less than the wavelength of the oscillation and the wave velocity considerably greater than the mean thermal velocity of the particles. Under these conditions, the change in the wave velocity due to thermal effects is calculated by means of an eigenvalue method which uses the wave velocity in the absence of thermal effects and the calculated dielectric tensor. (auth)

21670 (d-d) REACTION PRODUCT VELOCITIES IN SCEPTRE III ACCORDING TO A TWO-GROUP MODEL. R. Herdan and T. P. Hughes (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 987-96(May 1, 1961).

The relation is given between the drift velocity Δ of a hot group of deuterons, mixing with a cooler stationary group, and the mean center-of-mass velocity (W) of reacting deuteron pairs. Subject to certain restrictions on temperatures and densities, $(W)/\Delta$ can be as high as 3 or more. It is suggested that departures from the Maxwellian distribution may make the ratio large enough to explain results obtained with Sceptre III, without invoking any acceleration other than that due to the applied electric field. (auth)

21671 EMISSION OF SUB-MILLIMETRE ELECTROMAGNETIC RADIATION FROM HOT PLASMA IN ZETA. G. N. Harding (Atomic Energy Research Establishment, Harwell, Berks, Eng.), M. F. Kimmitt, J. H. Ludlow, P. Porteous, A. C. Prior, and V. Roberts. Proc. Phys. Soc. (London), 77: 1069-75(May 1, 1961).

First results are reported of plasma experiments using the technique of spectroscopy in the far infrared region (wavelength 0.1 to 1.6 mm). The shapes of the spectra obtained from Zeta are consistent with the observed radiation, being entirely due to free-free transitions (bremsstrahlung) and becoming characteristic of black-body emission at longer wavelengths. The measured absolute values of the surface brightness of the discharge agree generally with the predictions of quantum theory. (auth)

21672 THE OSCILLATING-ELECTRON PLASMA SOURCE. R. G. Meyerand, Jr. (United Aircraft Corp., East Hartford, Conn.). p.81-90 of "Electrostatic Propulsion." David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., eds. New York, Academic Press, 1961.

The oscillating-electron plasma source can produce a space charge neutralized plasma beam suitable for low thrust space missions. In addition to the fact that the plasma beam is space charge neutralized and does not require electron injection for charge equality, the plasma source has a number of other advantages. Since it is a bombardment-type source, any material which can be vaporized at reasonable temperatures may be used as an expellant. Among the expellants that were used are helium, neon, argon, krypton, nitrogen, hydrogen, mercury, and carbon dioxide. An additional advantage is that the source can operate within a wide range of specific impulse with reasonably constant efficiency. The last and perhaps most important advantage is that the source can operate simultaneously under space charge neutralized conditions with no net current emitted from the source. (auth)

21673 PLASMAS AND CONTROLLED FUSION. David J Rose and Melville Clark, Jr. Cambridge, Mass., Massachusetts Institute of Technology and New York, John Wiley & Sons, Inc., 1961. 505p.

The principles underlying plasma physics and controlled fusion are presented. Plasma physics, hydromagnetics, and elementary gaseous electronics in association with transport and electromagnetic theories are covered in the first part. The last part dwells more specifically upon the controlled fusion problem, including experimental and theoretical approaches, and methods of eventual energy recovery. (N.W.R.)

21674 PLASMA THERMIONICS. H. W. Lewis (Univ. of Wisconsin, Madison). p.133-6 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The source of positive ions in the plasma thermocouple, operating in the domain in which the thermal electron mean free path is much less than the plate spacing, and the pressure is much higher than necessary to achieve "space-charge neutralization" was considered. The conclusion was that the predominant ionization mechanism involves the heating of the electron gas to temperatures

vell above the cathode temperature, so that impact ionization by electrons is adequate. Further, the generation of plasma waves plays an essential role in converting the organized electron motion to heat, a mechanism that was tacitly assumed, but not mentioned, in earlier work. (auth)

21675 EXPERIMENTAL RESEARCH ON PLASMA THERMIONIC ENERGY CONVERTERS. Karl G. Hernqvist (RCA Labs., Princeton, N. J.). p.167-75 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Work pertaining to thermionic energy converters (T.E.C.) in which the electron space charge is neutralized by positive ion injection into the interelectrode space is described. A method of representing the potential energy diagram for the plasma is described, which facilitates the understanding of the interaction between plasmas and solids. Based on this model a detailed plasma energy balance consideration is given, for different types of cathode materials. Results of a theoretical analysis of the space charge problem of a cesium plasma type T.E.C. are described. The cases studied were for the simplest space charge states corresponding to a single potential maximum or a single potential minimum with an arbitrary applied potential between the electrodes. Based on this analysis, existence limits involving the operational parameters of electronic and ionic charge density, cathode-to-anode spacing, cathode temperature, and load impedance were obtained. It was found from the analysis that there exists a steady state region as well as one where no such steady state is allowed. In the latter case, the potential fluctuates between a potential maximum and a potential minimum at a rate determined by the ion transit time. The different space charge states that are possible when ions and electrons are injected into the interelectrode space are briefly discussed. (auth)

21676 THEORY OF THE CESIUM PLASMA ENERGY CONVERTER WITH A TUNGSTEN CATHODE. Howard L. Steele (Boeing Scientific Research Labs., Seattle). p.177-99 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The behavior of a diode converter with a tungsten cathode and containing cesium can best be described by considering three different ranges of cesium pressure. In the lowest pressure range the cesium ions produced are not sufficient to completely neutralize electron space charge and the diode is essentially a vacuum diode. The middle pressure range extends from the pressure where neutralization is accomplished through pressures where there is a positive ion space charge and up to a pressure where cesium can remain on the tungsten and reduce the work function. At this pressure electron space charge again dominates and at about this same pressure the mean free path of an electron is equal to the diode spacing. This higher pressure electron space charge condition separates the middle pressure or plasma diode range from the high pressure or plasma thermocouple range. A method of measuring the rate of ionization at a hot cathode surface and a method of determining electron temperature in the two lower regions are presented. Using the ion currents corresponding to these ion production rates the open circuit voltages are correctly predicted in the two lower pressure regions without considering space charge or diffusion of electrons or ions back to the cathode. Short circuit current and the current giving maximum efficiency both are reduced by electron space charge at the pressures between the medium and high pressure regions. In a vacuum converter electron space charge produces a potential minimum at less than a thousandth of an inch from the cathode. The current passed by the diode and thus the diode efficiency can be increased by making the anode to cathode spacing less than this distance. It is shown that current and efficiency also increase with decreasing spacing at those pressures between the medium and low pressure regions. If still higher pressures are acceptable it may be possible to produce enough ions to neutralize this space charge and eliminate the need for this close spacing. Future designers must trade off the difficulties of making close space diodes against the difficulties of making long life diodes which operate with the coldest spot equal to 450°C or greater. (auth)

21677 ON THE MAGNETOGASDYNAMICS OF COMPRESSIBLE VORTICES. James E. McCune and Coleman duP. Donaldson (Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.). p.715-41 of "Energy Conversion for Space Power." Nathan W. Snyder, ed. New York, Academic Press, 1961.

Basic solutions are presented for the steady spiral motion of a viscous electrically conducting gas, moving either inward or outward in the presence of an axial magnetic field between two concentric porous electrodes. The motion is maintained by one electrode rotating relative to the other. The character of the solutions obtained depends upon many parameters, but the salient features of the motion are determined by the magnetic interaction parameter, the ratio of the current drawn to the current available when the electrodes are short-circuited externally, and the ratio of the radii of the electrodes. The tangential velocity profiles may be determined independently of either the compressibility or the conductivity of the gas considered. If an average or constant scalar conductivity is assumed, the voltage developed can be determined quite simply as a function of the current drawn from the electrodes. Typical results are presented and compared with a few solutions obtained for variable conductivity. Approximate methods for solving the remaining magnetogasdynamic equations are discussed, and results giving the behavior of the thermodynamic variables are shown for typical inflow and outflow cases. The results presented indicate that such a device may be useful as a power generator. An appropriate efficiency for the device operating as a power generator is defined, and the inflow and outflow configurations compared. (auth)

21678 THE DIRECT-CURRENT EXPERIMENT (DCX) AND HIGH-TEMPERATURE MEASUREMENTS IN THE CARBON ARC. J. R. McNally, Jr. (Oak Ridge National Lab., Tenn.). p.70-94 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

The theory of the direct-current experiment (DCX) which involves the trapping of an energetic proton (or deuteron) ion beam in a magnetic mirror by the dissociation of 600-kev molecular hydrogen ions in a highly ionized carbon arc is explained along with experimental data from spectroscopic studies of the temperature of the carbon arc. The temperature parameter of the excitation and the degree of ionization are obtained from the relative line intensities. (N.W.R.)

21679 SPECTROMETRIC DETERMINATION OF ELECTRON TEMPERATURES ABOVE 100 ev. T. F. Stratton (Los Alamos Scientific Lab., N. Mex.). p.99-112 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

The continuous radiation spectrum from low density

plasmas which approach a steady state and which possess nearly Maxwellian electron velocity distributions is discussed. An examination of the continuous radiation spectrum shows that the electron temperature can be obtained from the spectral shape and that the ion and electron densities can be inferred from the absolute intensity and the electron temperature. Relations governing the free-free and free-bound continua and the dependence of ionic concentrations on temperature are presented for plasma sources with these characteristics. The governing relations discussed are bremsstrahlung radiation, recombination radiation, ionic populations, and the continuous spectrum. These spectroscopic techniques are applied to the Scylla magnetic compression experiment to show that, at peak compression, the deuterium plasma attains an electron temperature of 240 ev and an electron density of 5×10^{16} cm^{-3}. Also obtained were x-ray and visible light measurements and the radiation spectrum. (N.W.R.)

21680 EXPERIMENTAL STUDIES OF THE TEMPERATURE IN A FIELD-FREE PLASMA. P. J. Dickerman and J. C. Morris (Univ. of Chicago). p.170-80 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

Measurements made on the discharge of a 1-Mw air-stablized arc are described. The temperature range is found to extend from roughly 4000 to 17000°K at the orfice. Since the radiation in most of the available wavelength region often represents a mixture of band, line, and continuum transitions, the plasma temperature determinations are complex. Observations are made by means of both parent gas and electrode impurity emissions. In the analysis of continuum radiation it is most convenient to measure temperatures from the upper limit down to 10000°K near the orfice. CN and C_2 bands are used in the 6000 to 10000°K region, and atomic iron lines are used at the lower temperatures. The combination of the three procedures, along with the use of Abel's integral equation, provides temperature profiles and equilibrium information in the discharge. The data are presented in the form of radial temperature profiles and an axial temperature distribution. (N.W.R.)

21681 DIAGNOSTICS OF HIGH-TEMPERATURE PLASMAS PRODUCED BY STRONG SHOCK WAVES. A. C. Kolb (U. S. Naval Research Lab., Washington, D. C.). p.187-96 of "Optical Spectrometric Measurements of High Temperatures." Philip J. Dickerman, ed. Chicago, University of Chicago Press, 1961.

Thermodynamic properties of a gas at high temperatures are discussed in terms of the equilibrium properties of shock-heated plasmas. Experimental conditions for a helium plasma are chosen so that equilibrium (translational, excitation, and ionization) could be expected in order to prove, by purely spectroscopic means, that equilibrium conditions exist. A secondary purpose is to compare measured densities and temperatures with those calculated from the Rankine-Hugoniot equations, using measured shock velocities. The temperatures and densities are calculated from the usual spectroscopic equations and the Saha equation, including temperature corrections to the partition functions and the lowering of the ionization potential. From this experiment, a shock wave for measuring temperatures in the million degree range, where both the ions and the electrons are nearly Maxwellian, is discussed. (N.W.R.)

21682 IMPROVEMENTS RELATING TO METAL ENCLOSURES FOR ELECTRICAL DISCHARGE APPARATUS. Alan Alfred Ware (to Associated Electrical Industries, Ltd.). British Patent 868,862. May 25, 1961.

A tubular metal enclosure which may be straight or toroidal and can be used for heavy current electrical discharge devices, thermonuclear reactors, is described. The enclosure consists of a series of tubes connected mechanically end to end with the tubes being separated electrically by gaps extending annularly above the axis of the tubes. The ends of the tubes adjacent to the gaps overlap in a direction along the axis with interposed electrical insulation forming a vacuum seal around the outsides of the gaps. The electrical insulation adjacent to the inner face of the enclosure wall seals and gaps against the entry of arc spots. (N.W.R.)

21683 DESTRUCTION OF NEUTRON PARTICLES IN THERMONUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 869,344. May 31, 1961.

A method and apparatus for "burning out" neutral particles in a thermonuclear reactor is described. The method consists of forming a thermonuclear plasma within a confining magnetic field which surrounds an evacuated zone containing neutron particles. The method comprises establishing an arc discharge within the zone and parallel to the magnetic field and producing a current of atomic ions within the zone to permit ionization of the neutral particles whereby the atomic ions remove the neutral particles from the zone. This procedure allows a plasma to form in the zone. The current of atomic ions is at least equal in magnitude to the product of the current of neutral particles entering the zone and the probability that a neutral particle will undergo an exchange reaction before an ionizing reaction is likely. The injected ions in the pressurized zone are deuterium ions. The ions are at an average energy of 600 kev and the pressure is 10^{-6} mm Hg. Relations for current of the ions is also given and discussed. The apparatus is described for forming the thermonuclear plasma within a confining magnetic field. (N.W.R.)

21684 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUSION REACTORS. Goro Miyamoto and Giichi Iwata. British Patent 869,898. June 7, 1961.

The design of a thermonuclear reactor and the method for producing a combined electrostatic-magnetic field are described. The method consists of establishing a substantially hyperboloidal electrostatic field, establishing a substantially homogeneous magnetic field directed substantially axially of the electrostatic field, introducing ions into the fields along an ion path which passes through the center of the electrostatic field, whereby to cause ions of the same mass to charge ratio which are scattered at any instant from the center of the electrostatic field to be all returned to the center at another instant and progressively increasing the strength of the electrostatic and electromagnetic fields while keeping the ratio V^2 to B constant where: $\phi = V/2L^2 (-x^2 - y^2 + 2z^2)$ is the electrostatic field. B is the strength of the magnetic field, V is a reference potential, L is a reference length, and x, y, and z are the rectangular Cartesian co-ordinates of the point. A method for withdrawing energy from the reaction by passing cooling fluid through hollow annular electrodes by means of which the electrostatic field is established is also described. The reactor consists of a series of equally spaced parallel annular electrodes insulated from one another, ion injectors for establishing a hyperboloidal electrostatic field to the electrode potentials, and magnetic pole pieces for producing a homogeneous magnetic field directed axially of the electrostatic field. The annular electrodes lie on the surface of a sphere. (N.W.R.)

21685 METHOD OF PRODUCING THERMONUCLEAR REACTIONS. Erich Bagge (to Kurt Diebner). Canadian Patent 615,908. Mar. 7, 1961.

A method for igniting thermonuclear fuels, such as deurium or tritium, to promote thermonuclear reactions is scribed. The method consists of detonating an explosive harge in the form of a hollow body surrounding the fuel, ereby generating a converging shock wave in the interior the hollow bodies of the explosives, and creating a conntrated electrical discharge in the fuel at the center of nvergence of the shock wave in order to attain a temrature sufficient for ignition. (N.W.R.)

1686 NUCLEAR FUSION METHOD AND REACTOR HEREFOR. Théodore Volochine. Canadian Patent 6,116. Mar. 14, 1961.

A method and reactor for releasing nuclear power under bstantially ordinary temperature conditions is described. he reactor consists of a reaction zone, a source of a first eam of particles, and a source of a second beam of parcles. Both sources are connected to the reaction zone. here is a movable mounting system for selectively alterg the angular relationship between the connecting means the sources from a parallel to a perpendicular relationip and vice versa, and magnetic means for selectively larizing the first and second particles in a selected rection and with a selected sign. There are cooling means d a movable abutter device interposed in one of the conecting means. A mass of moderator substances is interosed in one of the connecting means. A fusion method ing the above equipment is described where two parcles from the two sources will tend to assume a relative osition within the reaction zone such that the magnetic oments set up attractive forces between the particles d that the vector sums of the spins and the vector sums the magnetic moments are equal to that of a stable parcle. The particles may be neutrons, protons, deuterons, helium-3 nuclei. (N.W.R.)

1687 STABILIZED ANNULAR PLASMA APPARATUS. Lerre Hubert (to Commissariat à l'Energie Atomique). anadian Patent 617,327. Mar. 28, 1961.

A stabilized annular plasma device for creating by electomagnetic induction a high discharge current in a gas ntained under low pressure in an enclosed tubular chamr of toroidal shape is described. The apparatus consists a doughnut-shaped discharge tube containing a low pres-re atmosphere of an ionizable gas, means for inducting a gh discharge current to flow in the tube, a sheath of a nducting material closely surrounding the space inside e tube, the sheath being continuous except for a transrse cut between the ends, a band of an insulating mate-al filling the cut, a stabilizing winding surrounding the be, each turn being located in a plane substantially at ght angles to the portion of the center line of the tube by e turn, and means for passing direct current through the abilizing windings, the current inducing means being inpendent of the sheath of conducting material. (N.W.R.)

1688 NUCLEAR FUSION REACTOR. Goro Miyamoto nd Giichi Iwata. Canadian Patent 618,364. Apr. 18, 1961.

A thermonuclear reactor is described that produces a perbolic electrostatic field. The electrostatic potential ϕ any point in the field is given by $\phi = (V/2l^2)(-x^2 - y^2 + z^2)$, where V is a reference potential, l is a reference ngth, and x, y, and z are the rectangular Cartesian coornates of the point. The homogeneous magnetic field arallel with the symmetrical axis of the electrostatic eld consists of a series of spaced parallel annular elecodes insulated from one another for producing the elecostatic field and means for producing the magnetic field. he annular electrodes are equally spaced and lie on the outer surface of the sphere of the reactor. The electrodes are hollow for passing cooling fluid through them. Ion injectors are located between the adjacent annular electrodes and extend into the field in a path which passes through the center of the electrostatic field when the reactor is in operation. (N.W.R.)

Shielding

21689 (CF-61-4-97) PRELIMINARY MSRE GAMMA RAY SOURCE AND BIOLOGICAL SHIELDING SURVEY. D. W. Vroom (Oak Ridge National Lab., Tenn.). Apr. 28, 1961. 41p.

The major gamma ray sources and some of the resultant biological shielding requirements were evaluated at both full power operation and following shut down for the Molten Salt Reactor Experiment. The sources include gamma rays due to the fission events in the reactor and those associated with activation of materials. Shielding estimates were made for the reactor system cells and for some maintenance facilities. (auth)

21690 (LAMS-2474) RADIATION SHIELDING FOR TEST CELL "C." Charles Fenstermacher and James Henshall (Los Alamos Scientific Lab., N. Mex.). June 1959. Contract W-7405-ENG-36. 25p.

Information is presented, related to radiation shielding at test cell "C," for calculations of wall and roof thicknesses, radiation heating of front wall by gamma and neutron absorption, neutron activation in front face of test cell, γ-dose rates both direct and behind shadow shields at various distances, and dose produced by a reactor catastrophe. (auth)

21691 (NP-10264(p.135-59)) SHIP SHIELDING CALCULATIONS. C. F. Ksanda (Naval Radiological Defense Lab., San Francisco).

The general approach to computing ship shielding factors is outlined. In this approach, the dynamic source configurations produced by various nuclear detonations, the complex structures of ships, and interactions of radiations with ships are idealized. Equations for calculation purposes are discussed. Shielding factors derived from Test Baker of Operation Crossroads were found to give good agreement with calculated values. A pseudospectrum for iron and air or water is presented. (D.L.C.)

21692 (NP-10264(p.59A-159N)) SHIP SHIELDING CALCULATIONS COMPUTATIONAL RESULTS. C. F. Ksanda (Naval Radiological Defense Lab., San Francisco).

Shielding calculations for a number of important locations within the USS RANGER were completed for two cases: (1) activity deposited on the flight deck and (2) activity air-borne around the ship. The results for both cases are presented as plots of shielding factor vs. total plating thickness directly above the receiving point. (D.L.C.)

21693 WEDGE FILTERS: THEIR CONSTRUCTION AND USE WITH THE 22 MEVP. BETATRON. Earl van Roosenbeek and John H. Grimm (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston). Am. J. Roentgenol., Radium Therapy Nuclear Med., 84: 926-32(May 1961).

The physical aspects and construction details of wedge filters by a calculative method are presented for 22 Mevp roentgen rays. The calculative method produces isodose curves of wedged fields that are in good agreement with measured isodose curves. Their clinical application and volume distributions in 22 Mevp therapy are given. (auth)

21694 CONSTRUCTION OF THE CONCRETE SHIELDING OF THE KARLSRUHE REACTOR FR-2. Alfred Bauer

(Kernreaktor Bau- und Betriebs-G.m.b.H., Karlsruhe, Ger.) and Jürgen Seetzen. Beton- u. Stahlbetonbau, 55: No. 12, (Dec. 1960). 11p. (KFK-43). (In German)

The construction of the concrete shielding for the Karlsruhe Research Reactor FR2 is described. Questions in concrete technology which occurred in the construction of various movable parts of the shielding are also considered. A description of the building, the mortar mixing plant, and the arrangement of equipment in the shielding structure are given. Results of an investigation of concretes are presented. Other questions studied included: casing pressures, elastic deformation of the inner biological shield, corrosion of the equipment installed in the magnetite concrete, measurements of the solidification temperature, and the influence of temperature on the fusibility of the mortar. (M.C.G.)

21695 CONCRETE PROPERTIES RELEVANT TO REACTOR SHIELD BEHAVIOR. C. P. Thorne (Univ. of Sydney). J. Am. Concrete Inst., 32: 1491-1508(May 1961).

Available information on the factors affecting the properties of concrete relevant to the determination of the stresses in a reactor shield is examined in detail, and the need for further investigation of several of these properties is noted. As a result of this examination it is possible to state the type of concrete best suited to the particular requirements of reactor shielding. The effect of partial drying of the shield on the distribution of temperature and unrestrained strain is examined theoretically and it is shown that the distribution of moisture content in the shield is of major importance. (auth)

21696 RECENT WORK AT THE NATIONAL BUREAU OF STANDARDS ON MOMENTS CALCULATIONS. L. V. Spencer, C. M. Eisenhauer, and J. Coyne (National Bureau of Standards, [Washington, D. C.]). Trans. Am. Nuclear Soc., 4: No. 1, 29(June 1961).

21697 COMPARISON OF MEASURED AND CALCULATED THERMAL NEUTRON DISTRIBUTIONS IN HIGH TEMPERATURE WATER SHIELDING. D. C. Anderson, L. O. Herwig, and W. F. Vogelsang (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 30-1(June 1961).

21698 HAND CALCULATION METHOD FOR SHIELDING DISTRIBUTED PIPE SOURCES. R. M. Stevens and D. L. Gorman (George G. Sharp, Inc., New York). Trans. Am. Nuclear Soc., 4: No. 1, 31-2(June 1961).

21699 RAY TRACING SHIELDING SURVEY CODES FOR SNAP SHIELDS. C. A. Goetz, K. L. Rooney, and M. A. Boling (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 32-3(June 1961).

Theoretical Physics

21700 SPECTRAL INTEGRAL FOR THE REPRESENTATION OF THE SPACE-TIME TRANSLATION GROUP IN RELATIVISTIC QUANTUM THEORY. Armin Uhlmann (Jena Univ., Ger.). Ann. Phys. (N. Y.), 13: 453-62(June 1961).

The structure of the representation of the space-time translation group in relativistic quantum theory is examined by means of an operator spectral integral. There is one and only one operator-valued function on the complex forward cone that is an analytic continuation of that representation. (auth)

21701 COVARIANT SPIN OPERATORS AND ASSOCIATED CONVERSION LAWS FOR A SPINOR FIELD. F. Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10), 20: 280-96 (Apr. 16, 1961). (In English)

The convariant operators that may serve for the description of the spin of a Dirac field are considered. The physical meaning of these operators is discussed, with the aim of investigating the associated conservation laws in the case of an interacting spinor field. Particular attention is given to the case of a Dirac field interacting with an assigned electromagnetic field. Other operators, containing explicitly the coordinates, are then introduced, which also commute with the Dirac operator $D = \gamma_\mu \partial_\mu - m$ and lead therefore to conservation laws for a free spinor field. The validity of these conservation laws in the case of an interacting spinor field is again investigated, with a particular emphasis on the case when the source of interaction consists of an assigned electromagnetic field. (auth)

21702 NON-LOCAL TRANSFORMATIONS AND NON-LOCAL CONSERVATION LAWS FOR FREE FIELDS. F. Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10), 20: 297-315(Apr. 16, 1961). (In English)

Nonlocal transformations are introduced, which, when applied to fields obeying homogeneous nonzero mass equations, define new fields obeying massless equations. These transformations are used to extend to the case of massive fields the conservation laws connected with the invariance properties of massless equations. (auth)

21703 SCATTERING BY A GIVEN CLASS OF NON-CENTRAL FORCES. R. Vinh Mau and A. Martin (CERN, Geneva). Nuovo cimento (10), 20: 390-402(Apr. 16, 1961). (In English)

Attention is given to the simple properties of the partial wave scattering amplitude and corresponding radial functions derived from a potential that is comprised of a continuous superposition of exponential or Yukawa potentials. These results are extended to the case where non-central forces are present in the scattering of two spin one-half particles. A method is given for calculation of the S-matrix elements in terms of the inverse Laplace transforms of the various radial potentials. The analytic properties of these matrix elements and integral representations of the wave functions are obtained. (auth)

21704 A SOLVABLE MODEL OF FIELD THEORY. E. R. Caianiello and A. Campolattaro (Università, Naples and Scuola di Perfezionemento in Fisica Teorica e Nucleare, Naples). Nuovo cimento (10), 20: 422-6(Apr. 16, 1961). (In English)

The propagation kernels (K) for a Dirac spinor field coupled to a neutral boson field are given, for the case in which no external boson lines appear. The model obtained by setting the free boson propagator equal to 1 is studied. A solution is obtained for K, and it is shown that infinities arising in the kernels can be consistently removed by appropriate uses of limiting processes. (T.F.H.)

21705 FORMAL THEORY OF REARRANGEMENT COLLISIONS. Marvin H. Mittleman (Univ. of California, Livermore). Phys. Rev., 122: 1930-31(June 15, 1961).

A new formulation of the transition amplitude for the general rearrangement collision is presented. Optical potential ideas are used in the derivation but the final result contains no mention of the optical potential. The result is a matrix element with transitions only between mutually orthogonal states. (auth)

21706 CLASSIC INTERPRETATION OF QUANTUM MECHANICS. James Paul Wesley (Univ. of California, Livermore). Phys. Rev., 122: 1932-41(June 15, 1961).

It is assumed that quantum mechanics may be interpreted causally and that the Ψ function plays the role of a genera

; function for particle trajectories. By arguing that the function should not be interpreted as a probability ampli- le, a new method for generating particle trajectories is stulated. The four-momentum of a scalar particle is sumed to be given as the gradient of an unspecified nction $F(\Psi)$, where Ψ is a pure real solution of the Klein- rdon equation. Since the location of a particle is deter- ined solely by its trajectory, the probability distribution fers from $\Psi\Psi^*$; and therefore, ordinary experimental sults differing from the traditional theory may, in prin- ple, be predicted. Particle motion and trajectories are scussed for three examples: a free particle, a particle a box, and a double slit. (auth)

707 FINITE PETURBATION THEORY IN QUANTUM LECTRODYNAMICS. I. Bialynicki-Birula (Univ. of chester, N. Y.). Phys. Rev., 122: 1942-6(June 15, 1961). It is proved that no infinities appear in the power series pansion of the S matrix in quantum electrodynamics if rturbation procedure is used that is based on a certain operty of all renormalizable field theories. This property nsists in the fact that the dependence of solutions on the upling constant has a singular part, nonanalytic at g = 0. is singular dependence must be treated exactly, whereas e remaining, nonsingular, dependence can be expanded o a power series. This power series coincides with the ndard renormalized expansion. All renormalization nstants in every order remain finite, provided their ngular dependence on the coupling constant is treated actly. The problem of convergence of the whole series investigated. (auth)

708 NON-LINEAR FIELD THEORY. Jochen Lindner niversität, Mainz). Z. Naturforsch., 16a: 346-56(Apr. 61). (In German)

A solution method for the field equations of the non-linear ld theory of Bechert was developed which permits the st charge and mass distribution with electrostatic and avitation fields to be described in the Riemann space. A ecial solution leads to the static model of a Coulomb arge, which is held together by gravity force. Multi- rticle models are obtained when all particles are equally arged. Dynamic obstacles can not be eliminated in the esent unquantized form of the theory. The problem of a tating charge distribution with electromagnetic field, hich has a classic analogy to spin, is introduced. (tr-auth)

709 DISPERSION RELATIONS AND ELEMENTARY ARTICLES. C. De Witt and R. Omnes, eds. Paris, rmann and New York, John Wiley & Sons Inc., 1960. 671p.

Eight papers on dispersion relations and elementary rticles are presented. Six of the papers are in English d two are in French. Separate abstracts were prepared r seven papers. One was previously abstracted for A. (M.C.G.)

710 INTRODUCTION TO THE THEORY AND AP- LICATIONS OF DISPERSION RELATIONS. M. L. Gold- rger (Princeton Univ., N. J.). p. 15-157 of "Dispersion elations and Elementary Particles." C. De Witt and Omnes, eds. Paris, Hermann and New York, John iley & Sons Inc., 1960. (In English)

A discussion is presented of the historical background d non-relativistic theory, two dimensional representa- n, dispersion relations in the relativistic field theory, plications of dispersion relations to pion-nucleon scat- ring, applications of the forward scattering dispersion elations, and dispersion relations for non-forward scat- ring. The scattering of spinless particles by a time dependent local potential was considered using dispersion elations in the non-relativistic theory. It was established at the scattering amplitude in the non-relativistic theory, regarded as a function of energy and momentum transfer, satifies a dispersion relation in the energy variable provided the momentum transfer is held fixed and less than a certain amount. A study was then made to determine if the restriction on momentum transfer is necessary and whether a representation could be deduced which gives both energy and momentum transfer dependence. A method for characterizing physical states in quantum field theory is described. The problems of a scalar particle being scattered by an external scalar potential, the production of a pair of such particles by an external scalar potential, and forward and non-forward scattering of particles were considered. (M.C.G.)

21711 INVARIANCE IN RELATIVISTIC QUANTUM MECHANICS. A. S. Wightman (Princeton Univ., N. J.). p.159-226 of "Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In French)

A summary is presented of the basis for the ideas on relativistic invariance. The sections are entitled: I—Lorentz and Poincare Groups, II—States, Physically Possible or Not; Rays; Superselection Rules; Definition of Relativistic Invariance and Relativistic Symmetry; Relativistic Equivalence, III—Continuous Unitary Representations of the Group P; Extensions to Representations with a Factor Near the Group Including the Inversions, IV—Representation of Complete Theories, V—Infinitesimal and Observable Operators of Polarization, VI—Other Possible Representations, and VII—Definition of the Field Notation. (T.R.H.)

21712 ANALYTIC FUNCTIONS OF SEVERAL COMPLEX VARIABLES. A. S. Wightman (Princeton Univ., N. J.). p.227-315 of "Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

The theory of analytic functions is discussed. Topics covered include: definiton of an analytic function and an analytic continuation, holomorphy domains and holomorphy envelopes, the continuity theorem, characterization of the boundary of a holomorphy domain, the tube theorem, the Bergmann Weil formula, the Jost-Lehmann-Dyson representation, and Laplace transforms. (M.C.G.)

21713 DEMONSTRATION OF DISPERSION RELATIONS. R. Omnes (Service de Physique Mathematique, C.E.N., Saclay, France). p.317-85 of "Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In French)

The chapters are entitled: General Properties of the S Matrix, Reduction Formulas, Mathematical Mixtures, Dyson Formula and Associated Region of Holomorphy, Dispersion Relations for the Vertex, and Dispersion Relations for Reactions of Two Particles. (T.R.H.)

21714 PROPERTIES OF VACUUM EXPECTATION VALUES OF FIELD OPERATORS. A. O. G. Källen (Inst. of Theoretical Phys., Univ. of Lund, Sweden). p.387-454 of "Dispersion Relations and Elementary Particles." C. De Witt and R. Omnes, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

Vacuum expectation values of field operators are discussed. The field concept, the particle concept, general physical assumptions, reduction formulas, the two-point function, the three-point function, an integral representation of the three-point function, some properties of the n-point function, and some properties of the analyticity domain of the four-point function are described. (M.C.G.)

REACTOR TECHNOLOGY

General and Miscellaneous

21715 (AEEW-M-96) A METHOD AND PROGRAMME (BREACH) FOR PREDICTING THE FLOW DISTRIBUTION IN WATER COOLED REACTOR CORES. J. Randles and H. A. Roberts (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1961. 21p.

A method of evaluating the flow rate in individual reactor channels that may be applied to any type of water-cooled reactor in which boiling occurs is presented. The flow distribution is calculated with the aid of a Mercury autocode program, BREACH, which is described in detail. This program computes the steady state longitudinal void distribution and pressure drop in a single channel on the basis of the homogeneous model of two-phase flow. (auth)

21716 (AEEW-M-116) MERCURY PROGRAMME 560—SPHERICAL HARMONICS P_3 APPROXIMATION—ONE GROUP, CYLINDRICAL GEOMETRY. J. R. Askew and R. J. Brissenden (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Jan. 1961. 13p.

The Mercury program 560 which solves the transport problem in the P_3 approximation for infinite circular cylinders was extended to deal with anisotropic scattering. It is restricted to one energy group of neutrons. Two boundary conditions, reflective and infinite medium, are available, and air-gaps may be considered. The equations are solved by a propagation method which permits a large number of radial regions to be solved. The air-gaps are solved using the Marshak moments method. A full description of the facilities available and of the input-output format is given. (M.C.G.)

21717 (ANL-6345) CONVERGENCE OF TRANSPORT SOLUTIONS FOR THIN SLAB CELLS. D. Meneghetti (Argonne National Lab., Ill.). Apr. 1961. Contract W-31-109-eng-38. 24p.

Reported DSN calculations of reactivity worths of heterogeneities in ZPR-III fast critical assemblies, caused by use of various fuel plate and diluent thicknesses, have shown the necessity for high-order approximations to obtain convergence of flux shape and eigenvalue. Convergence properties of solutions for a simplified two-region, one-energy-group, repetitive slab cell having regional thicknesses and regional cross sections representative of those encountered in some energy groups of the previous three-group study are compared for DSN (N = 2, 4, 8, 16), single-spherical harmonics, PN (N = 1, 3, ... , 11, 13), and double spherical harmonics, DPN (N = 1, 2, 3, 4, 5), solutions for the case of a spatially constant unit source density in the alternate regions of the cell. Analogous uncollided flux solutions and an integral transport solution for uncollided flux showing effects of contributions of sources in neighboring cells upon the solution are obtained. As the angular width of the anisotropic flux component occurs predominantly in the region about $\mu = 0$, the "shape" of the spatial flux is largely determined by at most a few nearest-neighbor source regions, and the anisotropic component is largely the anisotropic component of the uncollided flux. Use of either a discrete ordinate method in which the quadrature angles and weights are assigned on the basis of an uncollided angular-flux estimate or an integral transport method in which the angular integration is accurately carried out is suggested for more effective convergence. For such quasi-homogeneous cells a simple hand-calculational method is presented in which the spatial flux "shape" is first obtained from an uncollided flux analysis, using an integral transport treatment requiring at most a few nearest neighbor regions and arising from "effective" regional source levels, based upon the constant flux of an equivalent homogeneous cell, which include the elastic scattering sources as well as the "actual" sources. The "level" of the uncollided flux "shape" is adjusted by a constant flux term to satisfy the neutron inventory requirement of total absorptions equal total "actual" sources. For multigroup solution the energy groups may be analogously treated independently by employing "effective" and "actual" regional source levels for each group based upon homogeneous cell multigroup flux levels. (auth)

21718 (APEX-587) MAGNETIC AUTOMATIC POWER-RANGE CONTROL FOR AN AIRCRAFT NUCLEAR REACTOR. J. A. Russell, S. F. Hemmenway, J. L. Scharf, and P. C. Sharr (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 1961. 19p.

The advantages of a magnetic power-range control system for an aircraft nuclear power plant are presented. Control system elements and computing devices are treated in detail, and the performance of a bread-board version of the control system is evaluated. (auth)

21719 (CF-61-4-83) NEUTRON LOSSES TO Pa^{233} IN THE AQUEOUS HOMOGENEOUS BREEDER REACTOR. J. W. Miller and L. G. Alexander (Oak Ridge National Lab., Tenn.). Apr. 26, 1961. 7p.

Neutron losses to Pa^{233} in the blanket of the AHBR were computed and compared for two cases: (1) concentration of Pa^{233} is maintained uniform by continuous mixing, and (2) batches of fertile material are shifted periodically from high- to low-flux regions of blanket. It was found that, if the fertile material is cycled through three radial positions in three days, the loss of neutrons to Pa^{233} is no more than one per cent greater than if it is mixed continuously. (auth)

21720 (CF-61-5-33) HFIR CONTROL ROD SEAL TEST. Interim Report. D. T. Jones and W. H. Kelley, Jr. (Oak Ridge National Lab., Tenn.). May 2, 1961. 4p.

Two control rod seal configurations for possible use in the High Flux Intensity Reactor were tested to failure in water at reactor design conditions of 1000 psig and 40 inch rod stroke. Molded neoprene seal rings with micarta backu rings were used in an aluminum holder for one test and an epoxy-lined holder for the other. The seals ran 3100 and 54,000 cycles respectively before leaking; the latter performance is tentatively acceptable. (auth)

21721 (CRRP-1006) THE SLOWING-DOWN SPECTRUM IN HETEROGENEOUS REACTORS. C. B. Bigham and R. M. Pearce (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 30, 1961. 39p. (AECL-1228)

Resonance detectors were used to measure fluxes at several energies in the slowing-down spectrum in ZEEP through NPD-type cells, NRX-type cells, through vacancies, and through the graphite reflector. The measurements were normalized to spectra obtained from 20-group age-diffusion calculations, and the agreement between theory and experiment is satisfactory. Deviations of the spectra from the 1/E-form arise from two causes: resonance capture causes depressions in the flux near the uranium, and the spatial non-uniformity of the fission sources

ıses an excess of high-energy neutrons close to the rod
l a deficit at the cell boundary. Spectral uncertainties
e seen to cause appreciable errors in calculating reso-
ıce absorption in lattices. (auth)

722 (CRRP-1014) THE EFFECT OF BI-DIREC-
ONAL FUELLING ON REACTIVITY. M. F. Duret
tomic Energy of Canada Ltd., Chalk River, Ont.). Apr.
61. 34p. (AECL-1235)

A computer program was written to study the effects of
-directional fuelling on the axial reactivity distribution
a reactor. A two dimensional model is used to estimate
e effect of different source strengths at alternate lattice
sitions (in a square lattice) on the slowing down density
a cell. The thermal flux distribution in a cell is deter-
ned in terms of the absorption in the fuel in that cell and
e results used to estimate the neutron spectrum and the
te of Pu production in the fuel. The average isotopic
nstitution during an irradiation of this lattice can then
calculated and thus the lattice parameters determined
a function of axial position in the reactor. The effect of
^{239} hold up in Np^{239}, absorption in Xe^{135} and a variable
l temperature are taken into account as functions of
ial position. The computer program which uses an itera-
n procedure to solve these equations is described briefly
l results obtained for the CANDU lattice are presented.
ıth)

723 (MND-P-3014-II) SNAP PROGRAMS. THERM-
NIC ISOTOPIC POWER SYSTEMS. Quarterly Progress
port No. 6, January 1 through March 31, 1961. (Martin
. Nuclear Div., Baltimore). 101p. Contract AT(30-3)-
7.

Progress in thermionic technology necessary for the de-
lopment of power supplies utilizing radioisotopes as heat
urces is reviewed. An investigation was made of the
aracteristics of cesium-filled thermionic converters op-
ating in the low temperature region. Parametric studies
re made of the cesium diode with a tantalum emitter and
back emission and operational characteristics were de-
rmined in the collision-free region. Work was continued
the vacuum diode generator, with emphasis on the de-
lopment of Generator 2B. Several significant design
anges were made. The sapphire spacer rods were re-
ıced by a peripheral ring support to provide the desired
ter-electrode spacing. Preliminary tests indicated that
e use of an oxidized molybdenum collector may be an ef-
ctive way of attaining and maintaining a collector work
ıction less than 1.9 volts. Studies were begun to design
encapsulated Cm^{242} heat source suitable for fueling the
cuum diode generator. Materials selected to be evaluated
r the fuel container were molybdenum, tungsten, and tan-
ıum alloys. (M.C.G.)

724 (NAA-SR-Memo-4796) OPTIMIZATION OF A
ONICAL RADIATOR FOR SNAP 2. R. A. Stone (Atomics
ternational. Div. of North American Aviation, Inc., Ca-
ga Park, Calif.). Dec. 28, 1959. 11p.

Data are presented on optimization of a conical radiator
r SNAP-2. It is noted that the optimum radiator will
igh 95 lbs. exclusive of manifold weight, and have a total
ea of 130 square feet. (J.R.D.)

725 (NAA-SR-Memo-4910) STRUCTURAL PROB-
EMS ASSOCIATED WITH DESIGN AND ANALYSIS OF THE
AP II RADIATOR-CONDENSER. H. L. Sujata (Atomics
ternational. Div. of North American Aviation, Inc., Ca-
ga Park, Calif.). Jan. 29, 1960. 5p.

A suggested program for structural analysis and design
SNAP II radiator-condenser is presented. The program
is arranged to evaluate vibratory behavior, structural in-
tegrity, and thermal load resistance. (J.R.D.)

21726 (NDA-2147-6) FAST REACTOR SAFETY. Quar-
terly Progress Report for the Period Ending March 31,
1961. J. Agresta and F. Beers (Nuclear Development As-
sociates, Inc., White Plains, N. Y.). Apr. 30, 1961. Con-
tract AT(30-1)-2303(XIII). 16p.

Sodium Coolant. Exploratory investigations of transient
forced convection heat transfer and a generalized fuel chan-
nel study were begun. Reactivity Coefficients. Results are
presented for a delayed negative power coefficient of the
conduction type acting in conjunction with a prompt (posi-
tive or negative) power coefficient. For the negative prompt
coefficient, instability never occurs, although finite reso-
nances are possible in the transfer function above some
threshold power. For the positive prompt coefficient, in-
stability occurs above a threshold power corresponding to
a transfer function resonance of infinite height, and the
resonance peak is considerably higher and occurs at lower
frequencies than for the negative prompt coefficient. (D.L.C.)

21727 (TID-12764) RECENT APPROXIMATE SOLU-
TIONS OF THE THERMAL SPACE-ENERGY PROBLEM.
Gerald P. Calame (Knolls Atomic Power Lab., Schenectady,
N. Y.). 1960. 4p.

For Presentation at Rensselaer Polytechnic Institute,
March 23, 1961.

Considerations are given for an energy-dependent
thermal-diffusion equation for a one-dimensional hetero-
geneous reactor, composed of discrete regions. A discus-
sion is given of work done in investigating the feasibility
of using expansions of the solution to the thermal-diffusion
equation to obtain rapid but reasonably accurate solutions
to the thermal space-energy problem. (B.O.G.)

21728 (WCAP-1432) MULTI-REGION REACTOR LAT-
TICE STUDIES. Quarterly Progress Report, January 1 –
March 31, 1961. Ira H. Coen (Westinghouse Electric Corp.
Atomic Power Dept., Pittsburgh). Apr. 1961. Contract
AT(30-1)-2176. 78p.

Progress in analytical studies and critical experiments
for the multi-region reactor lattice studies of the fuel cycle
development program is described. The experiments uti-
lized stainless steel clad uranium dioxide fuel rods of three
different enrichments and two moderating ratios. Per-
formance of the scheduled experiments with the 4.5:1 W/U
lattice was continued without interruption. The experi-
mental results are reported under the headings of critical-
ity measurements, flux distributions, and microscopic
parameter measurements. Criticality measurements were
made on various two- and three-region cores. Results for
loading, critical water height, banked rod position, and
peripheral fuel rod woth are tabulated. The cross section
schematic diagrams of the cores utilized are shown. The
cadmium ratios for gold and U^{235} in the moderators were
determined. Scans are shown of fuel rods, gold foils, and
U^{238} foils for water slots and for various slab materials
inserted in the slot. The parameters of the lattices studied
experimentally were calculated and the results were com-
pared with those obtained experimentally. (M.C.G.

21729 (CEA-tr-A-902) CONTRAINTES THERMIQUES
DANS LES PAROIS EN ACIER DE CAISSONS DE REAC-
TEURS SOUS FLUX DE NEUTRONS ET AVEC REFROIDIS-
SEMENT SUR UNE SEULE FACE. (Thermal Strain in the
Stainless Steel Walls of Reactor Vessels in a Neutron Flux
and with Cooling Only on One Face). Günther Grass.
Translated into French by Z. Tilliette from Atomkern-
energie, 4: 364-8(1959). 29p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 2160.

21730 (NP-tr-613) THERMAL CALCULATION OF THE OPERATING CHANNEL OF A NUCLEAR REACTOR. I. S. Kochenov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 2: No. 12, 64-7(1959). 7p.

A detailed treatment of the problem of calculating volumetric heat release in fuel elements with respect to channel length is presented in which a cosinusoidal approximation and a coefficient of nonuniformity of heat release are used. The case of local jumps in the cosine curve, e.g., those caused by neutron field jumps or fuel element deformations, is considered, and a local coefficient of nonuniformity is introduced. The possibility of the jumps being concentrated in one small region is discussed. (D.L.C.)

21731 (NP-tr-635) NUCLEAR REACTORS. E. (Ye.) M. Balabanov. Translated from "Yadernye Reaktory." (A publication of the Military Press of the USSR, Moscow, 1957). 268p.

Data on nuclear reactors, atomic power plants, and atomic engines are reviewed. Topics covered include the physical basis of nuclear processes, the nuclear chain process, physical processes in nuclear reactors, research nuclear reactors, nuclear power engineering, obtaining and utilizing radioactive substances, and thermonuclear reactions. (M.C.G.)

21732 THE UTILIZATION OF FISSION FRAGMENT ENERGY FOR THE FIXATION OF NITROGEN. Meyer Steinberg, Leon Green, and J. R. Powell (Brookhaven National Lab., Upton, N. Y.). A.I.Ch.E. Journal, 7: 329-35 (June 1961).

The principles involved in designing a process for the production of fixed nitrogen by the direct use of fission fragment recoil energy are reviewed. The problems concerned with the radiation chemistry, development of fuel element, reactor design, and chemical process design are pointed out. Possible solutions to these problems incorporated in a complete plant design are presented. An economic evaluation, comparing the chemonuclear process with other conventional processes, is made. However, at the present state of knowledge, there seems to be no clear-cut advantage over conventional processes, even based on a nuclear economy. (auth)

21733 SURFACE TREATMENTS IN THE CONSTRUCTION OF GAS-COOLED REACTORS. R. Darras. Bull. inform. sci. et tech. (Paris), No. 49: 19-34(Mar. 1961). (In French)

Treatments required by metallic surfaces in a nuclear area are defined, and the essential ideas on degassing, sealing, and anticorrosion coatings and actual applications of these principles are reviewed. The case of a graphite reactor cooled with carbon dioxide is particularly stressed, the importance of surface treatment in the design and construction being emphasized. Some other examples of surface treatments developed for particular purposes are given. (auth)

21734 REACTIVITY FLUCTUATIONS IN REACTOR SYSTEMS. L. G. Kemeny (Queen Mary Coll., London). Nuclear Eng., 6: No. 60, 208-13(May 1961).

A fundamental engineering problem of nuclear reactor systems is the analysis of the time-variation in reactivity and neutron flux distribution in the reactor core under conditions of autonomous and non-autonomous operation. An outline is given of four different ways in which the dynamic model of a reactor is formulated in order to predict the time behavior of new reactor types or to confirm the results of experiments. (auth)

21735 STRUCTURAL RESPONSE TO OSCILLATING COOLANT TEMPERATURES IN EBR-I, MARK II. R. G. Matlock and R. R. Smith (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 12(June 1961).

21736 THERMAL DEFLECTION OF A REACTOR FUEL ASSEMBLY FROM LINEAR AND NON-LINEAR TEMPERATURE GRADIENTS. C. G. Johnson (Convair, San Diego, Calif.) and E. A. Davis. Trans. Am. Nuclear Soc., 4: No. 1, 13-15(June 1961).

21737 THE STRESS AND DEFLECTION CHARACTERISTICS OF N. S. SAVANNAH FUEL ELEMENT CONTAINERS DUE TO INTERNAL-TO-EXTERNAL PRESSURE DIFFERENTIALS. T. A. Hughes and D. L. Mayer (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Am. Nuclear Soc., 4: No. 1, 15(June 1961).

21738 RESPONSE OF A SPHERICAL REACTOR CORE VESSEL TO INTERNAL DYNAMIC LOADING. M. A. Greenfield. Trans. Am. Nuclear Soc., 4: No. 1, 15-16(June 1961).

21739 DETERMINATION OF THERMAL UTILIZATION OF A LATTICE BY A METHOD OF IMAGES; A SEMI EMPIRICAL METHOD. L. Seren and L. H. Tang (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 16-17(June 1961).

21740 CALCULATION OF DOPPLER REACTIVITY EFFECT IN A PuO_2-UO_2 FUELED FAST REACTOR. P. Greebler and B. A. Hutchins (General Electric Co., San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 17(June 1961).

21741 THE DOPPLER COEFFICIENT OF REACTIVITY IN A FAST U-233–Th-232 REACTOR. F. R. Nakache and M. H. Kalos (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 17-18(June 1961).

21742 DOPPLER RESONANCE INTEGRAL COEFFICIENT OF UO_2 AND ThO_2. R. L. Crowther (General Electric Co., Pleasanton, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 18-19(June 1961).

21743 THE EFFECT OF FAST REACTOR CALCULATIONS OF FLUX DEPRESSION IN SCATTERING RESONANCES. R. B. Nicholson, P. F. Zweifel, and J. H. Ferziger (Atomic Power Development Assn., Inc., Detroit). Trans. Am. Nuclear Soc., 4: No. 1, 19(June 1961).

21744 THE REACTIVITY (K_{eff}) OF THE TERNARY SYSTEM ZIRCONIUM–WATER–URANIUM-235. G. P. Rutledge and F. A. Dobbe (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 21-2 (June 1961).

21745 THE USE OF Th-232 FOR LOCAL POWER FLATTENING IN URANIUM FUELED, HETEROGENEOUS NUCLEAR REACTORS. R. L. Crowther (General Electric Co., Pleasanton, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 22-3(June 1961).

21746 MEASUREMENT OF RAPID VARIATIONS OF NEUTRON FLUX IN REACTOR SAFETY STUDIES. R. N. Cordy and E. I. Gardner (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 26-7 (June 1961).

21747 BANG BANG REACTOR CONTROL. M. Ash (System Development Corp., Santa Monica, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 28(June 1961).

21748 A COMPARISON OF KEY NUCLEAR AND ECONOMIC FACTORS FOR THERMAL REACTOR FUELS. E. A. Eschbach and D. E. Deonigi (General Electric Co.,

chland, Wash.). Trans. Am. Nuclear Soc., 4: No. 1, -8(June 1961).

1749 SAFETY OF DIRECT CONVERSION, NUCLEAR UEL ELEMENTS UNDERGOING RAPID EXPONENTIAL OWER EXCURSIONS. R. A. Chapman (Texas Instruents, Inc., Dallas). Trans. Am. Nuclear Soc., 4: No. 1, (June 1961).

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1754 EXPERIMENTAL STUDIES OF THE EFFECT F SOME UPSTREAM STRUCTURAL MEMBERS ON RECTOR CORE FLOW. W. J. Taylor (Martin Co., Baltiore). Trans. Am. Nuclear Soc., 4: No. 1, 42-3(June 961).

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1758 CRITICAL MEASUREMENTS FOR THE KIWI-A UCLEAR PROPULSION TEST REACTOR. J. C. Hoogterp nd J. D. Orndoff (Los Alamos Scientific Lab., N. Mex.). rans. Am. Nuclear Soc., 4: No. 1, 55(June 1961).

1759 SPECIAL FEATURES OF THE ADVANCED PITHERMAL THORIUM REACTOR CRITICAL ASSEMLY. H. A. Morewitz, S. G. Carpenter, D. T. Eggen, and . Myhre (Atomics International, Canoga Park, Calif.). rans. Am. Nuclear Soc., 4: No. 1, 55-6(June 1961).

1760 NUCLEAR AND THERMODYNAMIC DETERMIATIONS OF FISSION CATCHER FOIL EFFICIENCY. . W. Churchill and J. F. Kunze (General Electric Co., daho Falls, Idaho). Trans. Am. Nuclear Soc., 4: No. 1, 61 June 1961).

1761 A PROCESS FOR CONTINUOUS VARIATION AND CONTROL OF THE SOLUBLE NEUTRON POISON CONCENTRATION IN THE COOLANT. A. B. Holt (Westnghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear oc., 4: No. 1, 64-5(June 1961).

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21763 DECONTAMINATION PROCESSES FOR BOILING WATER REACTORS. S. Siegel (General Electric Co., Pleasanton, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 66 (June 1961).

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21765 FISSION FRAGMENT ABSORPTION IN THE COOLANT CHANNELS OF FUELED, GAS-COOLED SAMPLES. J. R. Beeler, Jr. and J. L. McGurn (General Electric Co., Cincinnati). Trans. Am. Nuclear Soc., 4: No. 1, 67-8(June 1961).

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21767 ACOUSTICAL OSCILLATIONS IN BOILING WATER REACTOR SYSTEMS. H. Christensen and E. P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge). Trans. Am. Nuclear Soc., 4: No. 1, 69(June 1961).

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21770 A MECHANISM EXPLAINING THE INSTABILITY OF EBR-1, MARK II. R. R. Smith and R. G. Matlock (Argonne National Lab., Idaho Falls, Idaho). Trans. Am. Nuclear Soc., 4: No. 1, 71-2(June 1961).

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21772 REFLECTED-REACTOR KINETICS. C. E. Cohn (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 73(June 1961).

21773 A P1 AND SN THEORY CODE FOR STATIC AND DYNAMIC SYNTHESIS OF TWO-DIMENSIONAL FLUX AND REACTIVITY. D. H. Frederick, S. Glasser, T. M. Olsen, E. A. Schaefer, and D. E. Wolf (Martin Co., Baltimore). Trans. Am. Nuclear Soc., 4: No. 1, 74-5(June 1961).

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21776 THE EFFECT OF MODAL INTERACTION ON THE XENON INSTABILITY PROBLEM. G. L. Gyorey (Univ. of Michigan, Ann Arbor). Trans. Am. Nuclear Soc., 4: No. 1, 83(June 1961).

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21781 USE OF "ON SITE" ANALOG COMPUTER TO DETERMINE DYNAMIC CHARACTERISTICS OF THE SNAP-2 EXPERIMENTAL REACTOR (SER). J. Reichman and E. B. Ash (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 86-7(June 1961).

21782 REACTIVITY AND SPATIAL DISTRIBUTIONS IN MULTI-REGION LATTICES: COMPARISON BETWEEN ANALYSIS AND EXPERIMENT. W. J. Eich and W. P. Kovacik (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 100-1(June 1961).

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21784 ANALYSIS OF CRITICAL EXPERIMENTS WITH SLIGHTLY ENRICHED UO_2 CLUSTERS IN HEAVY WATER. J. D. Cleary (Westinghouse Electric Corp., Pittsburgh), B. Jennings, F. L. Langford, and W. H. Arnold, Jr. Trans. Am. Nuclear Soc., 4: No. 1, 102-3 (June 1961).

21785 NATURAL URANIUM-D_2O BUCKLINGS OVER AN EXTENDED RANGE OF PITCH AND FUEL ASSEMBLY SIZE. T. J. Hurley, Jr., H. R. Fike, and G. F. O'Neill (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nuclear Soc., 4: No. 1, 103-4(June 1961).

21786 HETEROGENEOUS URANIUM METAL–GRAPHITE CRITICAL EXPERIMENTS. C. A. Guderjahn (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 104(June 1961).

21787 CRITICAL EXPERIMENTS ON ENRICHED URANIUM STAINLESS STEEL WATER MODERATED LATTICES. L. M. Welshans and K. M. Johnson (Martin Co., Baltimore). Trans. Am. Nuclear Soc., 4: No. 1, 104-6(June 1961).

21788 K_{excess} AND CONTROL ROD WORTH VERSUS TEMPERATURE FOR A HETEROGENEOUS CORE. J. F. Kunze and R. N. Poole (General Electric Co., Idaho Falls, Idaho). Trans. Am. Nuclear Soc., 4: No. 1, 106(June 1961).

21789 MEASUREMENT OF SNAP EXPERIMENTAL REACTOR TEMPERATURE COEFFICIENTS. J. P. Beall (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 111-12(June 1961).

21790 PLUTONIUM RECYCLE REACTOR CRITICAL TESTS. J. R. Triplett, L. C. Schmid, R. E. Peterson, R. E. Dunn, and J. J. Regimbal (General Electric Co., Richland, Wash.). Trans. Am. Nuclear Soc., 4: No. 1, 115-16(June 1961).

21791 ENGINEERING CONSIDERATIONS FOR REMOTE REFABRICATION OF EBR-II FUEL ELEMENTS. A. B. Shuck and J. E. Ayer (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 117-18(June 1961).

21792 EQUIPMENT FOR REMOTE INJECTION CASTING OF EBR-II FUEL. H. F. Jelinek and G. M. Iverson (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 118-19(June 1961).

21793 EQUIPMENT FOR REMOTE DEMOLDING, SIZING, AND INSPECTION OF EBR-II CAST FUEL PINS. N. J. Carson, Jr. and S. B. Brak (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 119-20(June 1961).

21794 LEAK TESTING OF EBR-II FUEL RODS. A. P. Grunwald (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 120(June 1961).

21795 ASSEMBLY, SODIUM BONDING, AND BOND TESTING EBR-II FUEL RODS. T. C. Cameron and N. F. Hessler (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 120-2(June 1961).

21796 OPERATION OF EBWR ON NATURAL URANIUM FEED. W. E. Loewe, A. J. Jerri, D. A. Klopp, R. O. Lyday, C. W. Terrell, and W. E. Zagotta (Armour Research Foundation, Chicago). Trans. Am. Nuclear Soc., 4: No. 1, 122-3(June 1961).

21797 FUEL ELEMENT COOLANT CHANNEL AND OTHER SPACING MEASUREMENTS. C. V. Dodd and R. W. McClung (Oak Ridge National Lab., Tenn.). Trans. Am. Nuclear Soc., 4: No. 1, 136-7(June 1961).

21798 FUEL HANDLING PROCEDURES FOR ORGANIC MODERATED REACTORS. C. M. Keim (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 142-3(June 1961).

21799 SIGNIFICANT RESULTS OF THE GAS-COOLED REACTOR EXPERIMENT (GCRE) TEST OPERATION. R. E. Lightle and R. H. Chesworth (Aerojet-General Nucleonics, San Ramon, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 143-4(June 1961).

21800 REACTOR OPERATING ASPECTS OF THE KINETIC EXPERIMENT WATER BOILER PROGRAM. J. H. Roecker (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 144-5(June 1961).

21801 SNAP-2 EXPERIMENTAL REACTOR OPERATION HISTORY. M. W. Hulin (Atomics International, Canoga Park, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 145(June 1961).

21802 VII RASSEGNA INTERNAZIONALE ELETTRONICA E NUCLEARE. V CONGRESSO NUCLEARE 1960. VOLUME PRIMO. (VII International Electronic and Nuclear Review. V Nuclear Congress. Volume I). Rome, Comitato Nazionale Ricerche Nucleare, [1960]. 422p.

In volume I the 28 papers presented at the panel discussion on procedures for authorizing the construction and operation of nuclear plants, with reference to their location and other safety factors, and at the symposium on the aims and techniques of information and public relations in nuclear plant activities are compiled. (J.S.R.)

21803 USE OF ORGANIC SUBSTANCES AS MODERATOR AND COOLANT IN NUCLEAR POWER REACTORS. Maria Adele Bertolaccini and Pier Luigi Bertolaccini (C.A.M.E.N., Leghorn). p.431-76 of "VII Rassegna Internazionale Elettronica e Nucleare. V Congresso Nucleare 1960. Volume Secondo." Rome Comitato Nazionale Ricerche Nucleari, [1960]. (In Italian)

Investigations on the use of organic substances as reactor moderators and coolants and the results of the studies are reviewed. The initial studies indicated the superiority of the polyphenyls. Physical properties of various polyphenyls are tabulated. Then the effects of radiation and temperature are reviewed. The behavior of organic moderators in test loops under reactor operating conditions are discussed, and the results obtained with the OMRE are given. (J.S.R.)

21804 POWER CONVERSION STUDIES, HANFORD NEW PRODUCTION REACTOR, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, MARCH 1961. (United States. Congress. Joint Committee on Atomic Energy). 388p.

Five studies concerning the feasibility of electrical power production by the Hanford NPR are summarized. Correspondence between the AEC and the Joint Committee on Atomic Energy regarding the conversion of the reactor from production to production plus power is presented. The reactor is designed to originally be a production reactor, with the capability of later transition to a power generating operation in addition to the Pu production. (T.F.H.)

21805 DEVICE TO IMPROVE THE EFFICIENCY OF REFLECTORS IN NUCLEAR REACTORS. (to Brown, Boveri et Cie). Belgian Patent 576,447. Priority date, May 20, 1958.

As the scattering mean free path of the thermal neutrons is roughly proportional to the square root of the neutron temperature, i.e. to the mean kinetic energy of the neutrons, their temperature must be kept as high as possible. The neutron economy of the reactor is therefore improved by either heating up the reflector with the reactor coolant or surrounding the reflector with a heat-proof cover, or both. (EURATOM)

21806 REACTOR FUEL ELEMENT AND ITS MANUFACTURE. (to DEGUSSA). Belgian Patent 577,386. Priority date, Apr. 11, 1958.

In order to avoid the diffusion of poisons such as xenons-133, 135, 137, 138, 139 and kryptons-88 and 89 through the pores of a graphite moderator, substances such as aluminum, zirconium, titanium, barium or silicon carbides or nitrides, having a small neutron-capture cross-section are introduced in layers around the fissionable matter. These substances may be added as liquids or gasses and transformed into stable carbides by heating. (EURATOM)

21807 BURST SLUG DISPLAY IN GAS COOLED NUCLEAR REACTORS. J. Goupil (to C. E. A.). Belgian Patent 577,804, Priority date, Apr. 26, 1958.

Only short lived fission products can characterize a burst slug. Samples of gas from all reactor channels are led into separate chambers where an electrode energized negatively can precipitate Ru and Cs ions. A rotating commutator allows every electrode in turn to be grounded, so that the gas flowing into this particular chamber can retain its full activity and be analyzed later on in a common monitoring chamber fitted with an electrode and a detector. A suitable display panel indicates which channel is being examined at a given time. The main advantage of the device is that no valves are used in the gas sampling circuit. (EURATOM)

21808 NUCLEAR REACTOR WITH COOLING DEVICE FOR SPENT FUEL ELEMENTS. (to Brown, Boveri et Cie). Belgian Patent 578,700. Nov. 16, 1959.

Ceramic spent-fuel-elements, which are pebble-shaped, are gravity-fed into a vessel positioned below the core, this vessel being cooled by the reactor cooling system. Chutes permit the unrestricted flow of the spent fuel and necessitate very little maintenance. (EURATOM)

21809 MANUFACTURE OF FUEL ELEMENT FOR HIGH TEMPERATURE GAS-COOLED REACTORS. (to DEGUSSA). Belgian Patent 581,449. Priority date, Sept. 3, 1958.

Uranium or uranium oxide and graphite powders are mixed and sintered into uranium carbide inside a can made of a material having a low neutron-capture cross-section such as zirconium and silicon carbides. (EURATOM)

21810 FUEL FOR HIGH-TEMPERATURE NUCLEAR REACTORS. (to S. E. R. A. I.). Belgian Patent 589,062.

Metal cans or cladding for reactor fuel elements cannot be used when the operating temperature is high; in order to limit the diffusion of fission products, small amounts of zirconium, niobium, silicon or magnesium are incorporated to the ceramic type fuel. These metals, their oxides and carbides reduce the vapor pressure of the fission products. The uranium (or uranium dioxide) is mixed with reactor-grade carbon and preferably zirconium carbide, the mixture is compacted, degassed, and sintered under vacuum at 2000°C. (EURATOM)

21811 PRODUCTION OF NUCLEAR FUEL FOR HOMOGENEOUS BREEDER REACTORS. (to W. R. Grace and Co.). Belgian Patent 593,997.

In order to obtain a stable, non-corrosive, aqueous fuel suspension for homogeneous breeder reactors, minute particles of uranium and thorium oxides are coated with silica. The suspension is prepared by adding a silica suspension to a suspension of uranium and thorium oxides free from electrolytes, and concentrating to a density of 1.5. The pH is maintained between 7.5 and 9.5 by a small amount of sodium hydroxide. The uranium–thorium oxide suspension is prepared by dialysis of a solution of uranium and thorium nitrates. (EURATOM)

21812 IMPROVEMENTS IN OR RELATING TO SERVICING EQUIPMENT FOR NUCLEAR REACTORS. Robert Tait, Robert Hugh Hall, and Charles John MacFarlane (to United Kingdom Atomic Energy Authority). British Patent 866,301. Apr. 26, 1961.

Equipment for servicing a nuclear reactor is described. It comprises a television camera of elongate form contained within a casing, a tool holder rotatable within the casing in front of the camera and means passing between the casing and the camera for rotating the tool holder and for operating tools adapted to be fitted in the holder. The tool holder is rotated by an electric motor. A mechanical couple connects the tool holder with the motor. The camera and casing each derive their driving power from a flexible cable, the cables are bunched together and pass out of the casing in a single flexible sheath so that the equipment can be lowered and raised from a winding drum. The operating tool consists of a hook and guide diametrically opposed. Another tool consists of a two-arm grab spring-loaded tool to close and open by a cable passing between the casing and the camera. (N.W.R.)

21813 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. John Tatlock and John Alexander

Forbes Glass (to United Kingdom Atomic Energy Authority). British Patent 867,969. May 10, 1961.

A support for a fast reactor core of fuel elements with means allowing the insertion and withdrawal of neutron generating material for control purposes is described. It is comprised of a core of vertically oriented fuel elements having groups of fuel elements supported in carriers which are retained against gravity by association at their lower ends with operating mechanisms for controlled movement of carriers together with their groups of fuel elements into and out from the core and the carriers together with their groups of fuel elements being free to fall from the core under gravity by a coupling releasable in the mechanisms. (N.W.R.)

21814 IMPROVEMENTS IN OR RELATING TO AIR VENTILATING EQUIPMENT FOR NUCLEAR REACTORS. Dennis James Dawson and Dennis Ross Poulter (to United Kingdom Atomic Energy Authority). British Patent 868,672. May 25, 1961.

Air ventilating equipment for a reactor containment is described. The equipment consists of a compressor which withdraws air from the containment and passes it to a receiver at an elevated pressure, an outflow control valve between the receiver and the atmosphere and operable at a predetermined pressure, and a radioactivity detector adapted to cause discontinuance of the air withdrawal from the containment should a predetermined level of radioactivity be reached in the outflow air. The detector monitors air released from the receiver by the valve and is connected through a servo-mechanism to a cut-out for the compressor. A filter is located on the inlet side of the compressor for absorbing gaseous fission products and a second detector is located on the outlet side of the compressor whereby the efficiency of the filter can be observed. (N.W.R.)

21815 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Herbert Chilvers Knights and William Rodwell (to United Kingdom Atomic Energy Authority). British Patent 868,678. May 25, 1961.

A reactor consisting of a reactor core supported inside a horizontally oriented cylindrical pressure vessel combined with a support structure is described. The reactor is characterized in that the weight supports for the pressure vessel in the support structure and the weight supports for the core in the pressure vessel are radially acting relative to the pressure vessel and in line so as to avoid bending stresses in the pressure vessel due to the weight of the core. The core is located in the pressure vessel. The pressure vessel is located in the support structure along the uppermost surfaces of the core by longitudinal keys and keyways. The locating keys and keyways are provided with complementary tapered side faces to allow radial movement of the pressure vessel relative to the support structure. The pressure vessel is strapped to the support structure. The pressure vessel structure is also provided with a biological shield which is connected to the support structure with keys and keyways. (N.W.R.)

21816 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR MODERATOR STRUCTURES. Denis Roland Chambers Guttery (to United Kingdom Atomic Energy Authority). British Patent 869,282. May 31, 1961.

A restraint for use in applying a restraint force to a nuclear reactor moderator-reflector structure is described. The restraint consists of tie bars held in tension, cruciform housing for linking the bars together in a diamond pattern while allowing movement between the bars and housings, and pads on the housings for applying radial restraint to the moderator-reflector structure. The moderator-reflector structure is contained in a containment vessel and the tie bars are suspended from a box grid within the vessel. (N.W.R.)

21817 FUEL COMPOSITION FOR AQUEOUS HOMOGENEOUS NUCLEAR REACTORS. (to Allmanna Svenska Elektriska AB). British Patent 869,451. May 31, 1961.

Fuel composition for aqueous homogeneous reactors is described. The fuel consists of a fissile material in dissolved form, a fertile component in solid or suspended form and at least one dissolved salt of beryllium, magnesium, or aluminum. The fissile material is uranyl sulfate, the fertile component is thorium oxide, and the salt is a sulfate. The fuel is distributed in the reactor core zone fluid and the blanket zone fluid. The core zone fluid contains uranium in the form of uranyl sulfate, and the blanket zone fluid contains thorium in the form of thorium oxide. Both zones contain at least one dissolved salt of beryllium, magnesium, or aluminum. (N.W.R.)

21818 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Andrew Thomson Bowden (to C. A. Parsons & Co., Ltd.). British Patent 869,529. May 31, 1961.

A reactor fuel element of the type in which a solid nuclear fuel is housed in a sealed container is described. The surface of the fuel element contains recesses in the form of circumferential grooves, longitudinal grooves, or series of indentations. The sheath spans the recesses during the initial heating-up period in the reactor and it is sufficiently flexible that it can be displaced into the recesses under the pressure of a cooling medium flowing over the element. When expansion of the sheath takes place relative to the fuel, the displacement of the sheath takes the form of a fold in the recesses. (N.W.R.)

21819 IMPROVEMENTS IN DEVICES FOR INTRODUCING ELEMENTS, AND IN PARTICULAR FUEL RODS INTO NUCLEAR REACTORS AND/OR FOR WITHDRAWING SUCH ELEMENTS FROM SAID REACTORS. Roger Martin and Maurice Moulin (to Commissariat a l'Energie Atomique). British Patent 869,539. May 31, 1961.

A device for introducing or withdrawing fuel elements from channels in the core of a nuclear reactor is described. The device consists of at least one movable mounted tubular arm, one end is adapted to register within the casing with the free ends extending from the core. The tubes form extensions to the various channels and are shaped so that their free ends define a part spherical surface which is concave toward the tubular arm. Portions of the length of the tubes are adjacent to the free ends and extend radially of the surface for the passage of elements between the arm and the tubes. The arm is mounted for turning movement about two axes which intersect at the center of curvature of the part spherical surface and one is fixed and is the geometric axis of the surface. Methods are described for observing the movement of the fuel elements, and a light source and light detecting prism are also described for viewing. Mechanical equipment for the device is also described. (N.W.R.)

21820 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Arthur Firth (to United Kingdom Atomic Energy Authority). British Patent 869,560. May 31, 1961.

A control member adapted for movement in a control channel passing substantially vertically through the core structure of a nuclear reactor is described. The control

ember consists of an elongated casing with an attached fting cable. A movable member at the lower end of the asing, normally held by tension in the lifting cable in a osition which closes the lower end of the casing, is dapted to contain a loosely packed mass of discrete par-iculate bodies of material having a high neutron absorp-on. If the control member is prevented from being low-red into the channel, relaxation of the tension in the lifting able allows the movable member to move so as to open the ower end of the casing and discharge the mass of particu-ate bodies into the channel. The channel is lined with a ischargeable tube fitted at its lower end with a perforated ember allowing passage of coolant gas through the tube ut providing for retention of the spherical bodies in the ube when they are discharged. (N.W.R.)

1821 IMPROVEMENTS IN OR RELATING TO NU-LEAR REACTORS. Nathaniel Quentin Lawrence and ennis William Ginns (to United Kingdom Atomic Energy uthority). British Patent 869,598. May 31, 1961.

A shut-down mechanism for a reactor or pile is de-cribed. The mechanism provides for the rapid insertion nto the pile of a neutron absorbent mass causing the chain eaction to stop. The mechanism consists of a tube stepped n internal diameter and a rod stepped in external diameter. When the rod is inserted into the tube a radiation trap is ormed. The rod is held by an electromagnetic detent neans to keep it from falling into the tube due to gravita-ional forces. The rod is adapted to be responsive to fluid ressure in the tube in order that it may fall into the tube nd make the radiation trap. (N.W.R.)

1822 IMPROVEMENTS IN OR RELATING TO NU-LEAR REACTORS. Nathaniel Quentin Lawrence and ennis William Ginns (to United Kingdom Atomic Energy uthority). British Patent 869,599. May 31, 1961.

A reactor which utilizes the capture or absorption of eutrons for the rapid regulation or control of the energy utput is described. The pile consists of a shielded mass f moderator material having channels passing through the hielding mass and moderator and interchangeable units in he channels. Some of the interchangeable units contain issile material and others contain neutron-absorbent mate-ial movable into and out from the moderator. The fluid low connections to the units are external to the shielded hass. (N.W.R.)

1823 IMPROVEMENTS IN OR RELATING TO FUEL LEMENTS. Robert Flinders Jackson and Graham Thomas hears (to United Kingdom Atomic Energy Authority). ritish Patent 869,645. June 7, 1961.

A reactor fuel element is described comprising a fuel ember enclosed in a protective sheath, having within the heath a device selected so as to be affected by a given hysical condition in a manner detectable after the condi-ion has changed. The device becomes radioactive under rradiation and can be subsequently counted to determine he extent of the irradiation. The device consists of either cobalt foil or boron or boron carbide dispersed in an luminum matrix. The fuel element is provided with heat-nsulating discs at the ends of the fuel member. At least ne of the discs contains a cavity where the device is in-erted. An additional cavity communicates with the cavity ontaining the device so that the device can deform into the dditional cavity on melting of at least part of the device. N.W.R.)

21824 IMPROVEMENTS IN OR RELATING TO NU-LEAR REACTORS. Alan James Morton (to Hawker Sid-eley Nuclear Power Co., Ltd.). British Patent 869,647. une 7, 1961.

A control rod handling mechanism for a nuclear reactor is described. The control rod may be moved in a vertical direction in the reactor. There are two projections extending laterally from the rod, each projection being movable about the axis of travel of the rod. There is provided in respect of each projection a support for receiving the projection and consisting of a ramp. The first profile forms a guide for the projection during upward travel to a position for lowering on to the ramp and down the ramp to a rest position. The second profile forms a guide for the projection during upward movement from the rest position to a position for lowering past the support. (N.W.R.)

21825 IMPROVEMENTS IN MACHINES FOR HANDLING OBJECTS, SUCH AS FUEL ELEMENTS, THAT ARE USED IN THE FUEL CHANNELS OF NUCLEAR REACTORS. Kenneth Thomas Peers Langdon (to Babcock & Wilcox, Ltd.). British Patent 869,832. June 7, 1961.

A machine for handling objects, such as fuel elements, that are used in the fuel channels of a gas-cooled reactor and which may be adapted, having regard to its size, to provide an improved capacity, is described. It is used in charging or discharging fuel elements from a reactor. The machine includes a magazine provided with a number of chambers arranged in a plurality of circular series disposed so that a part of any series lies within another, a housing containing the magazine, guides for moving objects along a predetermined path into and out of the housing and the chambers of the magazine, and means for rotating the magazine and moving the magazine laterally relatively to the housing so that the chambers can be brought sequentially into the predetermined path. (N.W.R.)

21826 NUCLEAR REACTOR SCRAM APPARATUS. Hermann Kumpf (to Siemens-Schuckertwerke A. G.). Canadian Patent 612,009. Jan. 3, 1961.

A shutdown or scram apparatus for a fluid cooled nuclear reactor is described. The device consists of a hopper arranged above a safety tube in the lattice of the reactor. The hopper is adapted to contain a plurality of spherical pieces of neutron absorbing material. The pieces are maintained in the hopper by the pressure of the coolant in the safety tube whereby a decrease in the pressure of the coolant permits the pieces to descend into the safety tube and shutdown the reactor. The device is equipped with safety valves and may be adapted as is shown to feed the particles one at a time. (N.W.R.)

21827 LATCHING DEVICES FOR NUCLEAR FUEL ELEMENTS. Maurice P. A. Moulin (to Commissariat à l'Energie Atomique). Canadian Patent 612,848. Jan. 17, 1961.

A latching device for holding columns of fuel slugs in position in the channels of a reactor is described. The latch may be operated by automatic remote control with an accuracy sufficient to eliminate the possibility of jamming or other defective operation. The latch is simple and has high resistance to mechanical, thermal, and neutron stresses. The latching mechanism consists of a hollow body provided with latching fingers. The fingers are movable and are adapted to project from the body. The mechanism also includes a slidable member which is movable longitudinally with respect to the body between two end positions, this member acts in opposite direction of the fingers and engages the side of the body for locking the fingers. When the fingers move in the reverse direction from the locked position the slidable member automatically releases the body. (N.W.R.)

21828 NUCLEAR REACTORS. Michel Grenon, Louis Berthod, Georges Cohen de Lara, Michel Delachanal, and

Georges Halbronn (to Commissariat à l'Energie Atomique). Canadian Patent 618,575. Apr. 18, 1961.

A boiling liquid homogeneous reactor in which the specific power is high and the critical mass is low per liter of core volume is described. The reactor consists of a stationary core and means for producing in the core a vortex flow of active fluid for separating the vapor. The core acts as a heat generator and as a vapor separator. The core vessel is in the form of a body of revolution and has an outlet located substantially along the axis of the core. There are means for producing in the core a vortex flow of active fluid to cause the vapor to be led by the centripetal force to the outlet. The means consists of a liquid injector. There is a heat exchanger connected with the core vessel outlet, and means for feeding the condensate formed in the heat exchanger to the injector. The feed rate of fluid injected into the core vessel corresponds to the flow rate of condensate supplied by the heat exchanger. There is also means for recycling to the injector a portion of the fluid in vortex movement in the core vessel. (N.W.R.)

21829 ATOMIC PILE-CORE AND STRUCTURE THEREFOR. Ian N. MacKay (to Atomic Energy of Canada, Ltd.). Canadian Patent 618,665. Apr. 18, 1961.

A core of aluminum-coated uranium rods arranged in a heavy water moderator of a reactor is described. The rod consists of a metallic uranium rod having an aluminum member joined to each end, an aluminum sheath surrounding the rod, and each member having longitudinally extending spacing ribs on its exterior surface, a sealing member on the lower end of the aluminum members, a tapered sealing member on the upper end of the aluminum, an annular tube surrounding the rod. The aluminum members and the sealing members are spaced by the ribs to form a passage for cooling fluid. There is a venturi-like arrangement on the top portion of the member and formed partly thereby, having an enlarged annular passage communicating with the first mentioned passage, a chamber below the lower end of the lower sealing member with which the first mentioned passage communicates, a venturi-like device beneath the chamber to provide a tortuous passage for the cooling fluid, and means for sealing off the annular tube about the top and bottom portions of the upper and lower venturi-like devices, respectively. (N.W.R.)

Power Reactors

21830 (DLCS-2760201) CONTROLLED SAFETY TEST ROD WITHDRAWAL TRANSIENTS (POWER RANGE). CORE I, SEED 2, EFPH 2248. Section 2. Test Results T-612393-C. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 20, 1961. 41p.

Tests were conducted to obtain data on the dynamic response of the plant to various power range control rod withdrawal transients. The Reactor plant responded generally as expected. Comparison of data with simulator studies revealed that transients were more severe and had less measurable differences between the 20, 40, and 60% power runs than those transients predicted. (J.R.D.)

21831 (DLCS-3350201) OPERATIONAL INVESTIGATION OF NUCLEAR INSTRUMENTATION. CORE I, SEED 2. Test Results (T-643725). Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 13, 1961. 24p.

The test data indicate that the response of the Intermediate-Range log-level-current instrumentation was linear between 5×10^{-11} to 5×10^{-7} amperes for start-up rates of 0.2 to 1.0 decades per minute based on the assumption that the reactor transient behavior can be predicted by the reactor kinetic equation. A comparison of the intermediate range start-up rate readings with the start-up rates determined from the slope of the intermediate-range log-level current as a function of time curves indicates that the intermediate-range start-up rate circuitry was properly aligned. The power inception point, determined from the intermediate-range log-level current and reactor coolant-temperature data, occurred at an average log-level current of 5×10^{-7} amperes, assuming that all of the heat of the pumps was disposed of by venting steam to atmosphere. The decade overlap of the intermediate range into the source range varied from 0.95 to 1.95 source range decades with an average overlap of 1.1 decades. The hot-to-cold attenuation, ratio of a source-range flux level (cps) at a primary coolant temperature of 500°F to source-range flux level (cps) at a primary coolant temperature of 135°F, was determined to be approx 2.3. (auth)

21832 (DLCS-3360101) PERIODIC CALIBRATION OF PRESSURE INSTRUMENTATION. CORE I, SEED 2. Section 1. Test Results T-643718. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 7, 1961. 14p.

Results are presented of tests conducted to determine and correct errors existing in the reactor coolant loop, pressurizer, and reactor pressure measuring instrumentation. (B.O.G.)

21833 (DLCS-3550101) STEAM GENERATOR TEST. 1C Loop, Babcock and Wilcox Steam Generator. CORE I, SEED 2. Test Results T-643701. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 21, 1961. 110p.

A test was conducted to provide operating data from the 1 C boiler for use in calculating circulation ratios, flow distribution in the downcomers and risers, steam purity, moisture carryover and over-all boiler performance. Data are included. (J.R.D.)

21834 (DLCS-3560101) REACTOR COOLANT FISSION PRODUCT ACTIVITY. CORE 1, SEED 2. EFPH 5806.1. Test Results T-643732. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 14, 1961. 6p.

Primary coolant water samples were taken from the Shippingport PWR demineralizer and analyzed radiometrically for the concentrations of I^{131} and I^{133}. The sampling was performed prior to criticality and at gross power levels of 5 to 49 Mwe. The results indicate that the activities of I^{131} and I^{133} increase proportionally with the power level. The results are to be used for comparison with future activity determinations. (D.L.C.)

21835 (DLCS-3560102) REACTOR COOLANT FISSION PRODUCT ACTIVITY. CORE 1, SEED 2. EFPH 149.9. Test Results T-643732. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 14, 1961. 7p.

Reactor coolant samples were taken periodically from the Shippingport PWR during reactor startup and analyzed radiochemically for I^{131} and I^{133} contents. The sampling was performed at the time when Seed 2 had been in service for a total of 149.9 EFPH and during a load increase to 67 Mw gross. The activities of I^{131} and I^{133} were found to increase to peaks during startup and then to decrease to steady-state values. The I^{131} peak and peaks observed on the Fedal Activity Monitor No. 2 indicate a fuel element defect. (D.L.C.)

21836 (DLCS-3630101) DYNAMIC RESPONSE OF REACTOR PLANT TO LOAD SWINGS. CORE 1, SEED 2. Test Results T-643738. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 20, 1961. 60p.

A test was conducted to determine the dynamic response

f the reactor plant to load swings, the effects of magnitude nd rate of load change on the plant, the effects of tempera- ure coefficient and rod motion on various parameters dur- ng the transient, and the capability of the pressurizer spray o reduce the magnitude of positive pressure surges. Data n plant response are included. (J.R.D.)

1837 (GA-1774) 40-MW(E) PROTOTYPE HIGH-EMPERATURE GAS-COOLED REACTOR RESEARCH .ND DEVELOPMENT PROGRAM. Quarterly Progress :eport for the Period Ending September 30, 1960. (Gen- ral Atomic Div., General Dynamics Corp., San Diego, :alif.). Apr. 1961. Contract AT(04-3)-314. 255p.

The more important developments in the HTGR program uring this quarter are summarized. The materials pro- ram continued to emphasize work on the development of ne all-graphite fuel element. Trial fuel compacts were abricated for use in the irradiation testing program. Some est compacts were made using as starting material fuel articles of uranium-thorium carbide coated with pyrolytic arbon. Such fuel compacts were found to have good re- istance to attack by moist air at temperatures of approxi- nately 50°C. Tracer experiments were carried out to neasure the holdup time for Xe^{133} at elevated tempera- ures in such compacts made from coated fuel particles. These experiments indicate that in the unirradiated con- ition, these compacts will hold up Xe^{133} for much longer imes than uncoated test compacts which have previously een prepared in our program. Experiments are being nitiated to study the holdup in heavily irradiated fuel com- acts. A continuing effort is being made to develop an im- regnation process to make low-permeability graphite. Some success has been attained in producing small samples with permeabilities as low as 10^{-6} cm^2/sec. Test pieces are ow being impregnated which have the full $3\frac{1}{2}$-in. fuel- lement diameter. The investigation of the possible migra- ion of U and Th within the fuel compacts at high tempera- ures has received continued study. Results to date indicate hat the phenomenon may be more complicated than was reviously supposed. These experiments indicate that the iffusion coefficient of Th and U in graphite is approxi- nately 2×10^{-9} cm^2/sec at 1950°C. Construction of the in- ile loop was approximately 80% complete at the end of this uarterly period. Good progress was made on the nuclear alculations necessary for the reactor core design. Speci- ications for the two-dimensional burnup code were com- leted and programming work is in progress. Calculations n the gamma-ray heating and fast-neutron doses in the ressure vessel were completed. Construction on the half- cale model of the reactor core and pressure vessel is well along and delivery of the model is expected in November, 1960. The instrumentation, the circulator, and all of the coolant ducts were completed. The critical facility achieved nitial criticality. Measurements were carried out to de- ermine the worth of the HTGR mockup control rods. The worth of two different rods having different boron concen- ration was determined in terms of distributed boron poison. The results obtained to date show that the worth of the reference-design HTGR control rod in its own cell of in- luence is approximately 20%. (auth)

21838 (GEAP-0972) DRESDEN REACTOR COOLING REQUIREMENTS AFTER RUPTURE OF AN INLET OR OUTLET PIPE. F. E. Tippets (General Electric Co. Atomic Power Equipment Dept., Schenectady, N. Y.). Mar. 1, 1957. 28p.

The variation in fuel temperature and emergency cooling requirements for the Dresden reactor are analyzed for the case of rupture of either an outlet riser or recirculating flow inlet pipe. It is calculated that periods of 12 and 9.6 min are available after rupture of the outlet and inlet, respectively, in which core cooling may be provided before the melting point of Zr is reached. (D.L.C.)

21839 (NAA-SR-5190) A COMPARISON OF TYPICAL FUEL CYCLE COSTS FOR THERMAL AND NONTHERMAL SODIUM-COOLED REACTORS. K. W. Foster (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 30, 1961. Contract AT(11-1)-GEN-8. 51p.

Preliminary nuclear, heat transfer, and fuel cycle cost data were prepared for thermal and nonthermal sodium-cooled reactors in order to determine the reactor type best suited for demonstrating economic nuclear power. UC and PuC–UC fuels are considered. At a burnup of 20,000 Mwd/MT, the various reactor types are ranked from least to most expensive in the following order: (1) paste fast, (2) solid-rod thermal, (3) solid-rod fast-thermal coupled, and (4) solid-rod fast. For a burnup of 50,000 Mwd/MT, (4) will be more economical than either (2) or (3). Since further development of (1) is required, the solid-rod thermal reactor with a fuel cycle cost of ~1.7 mills/edwh is recommended as the best reactor type for demonstration purposes. (D.L.C.)

21840 (NMI-7237) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission, February 1, 1961–February 28, 1961. S. Isserow, A. M. White, E. F. Jordan, W. J. Richmond, P. R. Smoot, H. M. Green, A. R. Gilman, and W. B. Tuffin (Nuclear Metals, Inc., Concord, Mass.). Apr. 24, 1961. Contract AT(30-1)-1565. 42p.

The development of components for heavy-water moderated reactors was continued. A continuation of the statistical study of the cladding thickness of various thin-walled outer tubes indicated that autoradiography may be used with confidence to determine uniformity of outer cladding. Design changes in the eddy current thickness tester appeared necessary before it can be used to determine cladding thickness variations. Cladding thickness variations were found to arise from relatively high frequency sinusoidal variations superimposed over gross variations that are related to the eccentricity of the wall. Changes in billet design and preparation and in extrusion technique were incorporated in the processing of two additional thin-walled outer tubes. Additional U–1 wt.% Si and unalloyed dingot uranium specimens were prepared for capsule irradiation. Directional solidification during brazing was found to be advantageous for the dingot specimens. Another ingot specimen was welded, hydrostatically recanned in copper, and beta treated. Work was continued on two experimental compositions for capsule irradiation. Clad U–0.3 wt.% Al–0.5 wt.% Si alloy had greater bond strength in the as-extruded condition than in either the beta or gamma treated condition and was relatively ductile. A slowly cooled and isothermally transformed U–0.3 wt.% Cr–0.3 wt.% Mo casting was evaluated to determine if it was free from cracks. A specimen produced by transient-melting the uranium core of a Zircaloy-clad tube at 45°C above the melting point was further evaluated. After cold working of four stainless steel-Zircaloy joints, the only visible defects were those which corresponded to irregularities that were not removed in the machining prior to cold working. (auth)

21841 (NP-10237) HALDEN II RESEARCH PROGRAMME. (Norway. Institutt for Atomenergi, Kjeller). May 1961. 29p.

An outline is given of the program to obtain a thorough

characterization of boiling water reactor dynamics by making measurements of microscopic parameters to devise reliable theoretical models which are generally applicable to boiling water reactors. Appendixes include the first- and second-charge design data, descriptions of in-core equipment for reactivity perturbation uses, a conceptual description of void-measuring equipment selected for Halden II development discussions and of the Halden In-Core Instrument meeting and the status of instrument development. (B.O.G.)

21842 (TID-12385) EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT. Contract Termination Report. (Sargent and Lundy, Chicago and Allis-Chalmers Mfg. Co., Milwaukee). Feb. 24, 1961. Contracts AT(11-1)-816 and AT(11-1)-832. 73p. (SL-1865)

An indexed tabulation is presented of the information design data, drawings, and all other pertinent contract documents developed during the execution of contracts on the ELPHR project. Work completion estimates are included. (D.L.C.)

21843 (WAPD-MRP-91) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD FEBRUARY 24, 1961 TO APRIL 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT-11-1-GEN-14. 123p.

PWR Core 2. The temperature coefficient of reactivity for Core 2 was calculated with a revised analytical model and is found to remain relatively constant through seed life. A redefinition of the fuel zone boundaries in the Core 2 seed cluster design was recommended to reduce local power peaks in the seed, and consequently, improve seed power capability. A study was initiated to revise the Core 2 mechanical hot channel factors associated with fuel dimensions and concentration to take advantage of random variations. Modifications were made to the mechanical design and instrumentation. Initial tests of the blanket assembly FEDAL sampling rake were completed. Fatigue testing of PWR-2-compartmented blanket-fuel plate cladding was resumed, using isostatic-pressure-bonded plates. General approval was received for the conceptual design of the electromechanical system for driving neutron sensitive wires into the six core-flux thimbles. The relative temperatures of the clad and fuel materials in Core 2 fuel elements, during quenching after beta heat treatment, were calculated to confirm conditions necessary for forming clearance volumes within the fuel compartments. In the compaction of blanket fuel wafers, end cracking was eliminated by modifications to the die. Improved adherency of the pyrolytic carbon coating on blanket wafers was obtained. The production of seed wafers was hampered by problems of contamination and an inability to produce a consistent isotopic content. Based on the results of the program to fabricate 21 half-length blanket fuel elements, it was recommended that a release be granted for fabrication of 10% of the Core 2 blanket fuel elements. Acceptable bonds were produced on plates containing the boron steel, poison wafers. An interim beta treating facility was installed. Plant Modification for Core 2. Design report on the utilization of the FEDAL sample piping for safety injection was submitted to the AEC. The design report on FEDAL operation, including integration with safety injection was also submitted. A recommendation for additional boiler steam relief valves was resubmitted. An evaluation of the adequacy of the neutron shield tank for Core 2 operation was submitted. Technical approval was received for the PWR Emergency Plan Drill procedures on minor airborne and waterborne release of radioactivity. Design drawings for the "AC" Rod Drive Static Inverter Prototype were approved. Specification for the Nuclear-Protection System was approved and released for quotations. The study of Turbine Heat Dissipation System interaction was completed. The Data Computer for the PWR Data Acquisition System was delivered to the Shippingport Site. Metallurgy of Core Materials. In-pile thermal conductivity measurements on UO_2, ZrO_2 + 34 wt.% UO_2, and ZrO_2 + 46 wt.% UO_2 were obtained for irradiations up to about 5×10^{20} fissions/cc. Samples of ZrO_2 + 34 wt.% UO_2 and ZrO_2 + 46 wt.% UO_2 were irradiated to 36.1×10^{20} and 41.6×10^{20} fissions/cc, respectively, and measurements of swelling were obtained. The results confirm design parameters presently in use for Core 2. Metallographic examination of ZrO_2 + 46 wt.% UO_2 irradiated to 23.6×10^{20} and 27.4×10^{20} fissions/cc showed the presence of small, spherical white particles which appear to be associated with regions of large porosity. Excellent bond quality of beta-treated blanket and seed oxide plates was obtained at bonding temperatures of 1550 to 1575°F and 1600 to 1625°F. A process was developed for applying adherent graphite-sprayed coatings to chromium-plated, borated stainless steel poison inserts. Impurity contamination causing formation of "white spot" inclusions in unirradiated sintered seed fuel wafers was found to be tramp iron introduced into the seed fuel during the crushing and size reduction steps in the fabrication process. Reactor Physics. A series of zero power physics tests were performed following 6140 EFPH of PWR Core 1 Seed 2 operation at Shippingport. A proposal was submitted for a U-235 fission product poisoning experiment in a hardened MTR spectrum. PWR Core 1. The behavior of the blanket fuel under irradiation was essentially as expected. Retention of the existing 17-4 PH stainless steel scram-shaft assemblies for service during Core 1 Seed 3 operation was recommended in view of the results of an extensive test program. It was recommended that two scram-shaft assemblies made of Inconel X be used for insertion in Seed 3 to provide a service test of this material. Coolant channels of two depleted Seed 1 clusters were probed by passing shim stock down the channel length. No gross distortion of fuel plates was found. Preliminary evaluation of Core 1 thermal performance with a third seed indicates that rated power can be achieved. Application of the XITE code to PWR Core 1 Seed 3 operation indicates that the two-dimensional model of channel flow and heat transfer does not always produce a relaxation of thermal limits. The effect on the thermal performance of Seeds 2 and 3 of new DNB data was evaluated. No change in operating limits of Seed 2 is indicated, although use of the new data results in tighter thermal limits. Reduction of overpower scram setpoints for Seed 3 operation may be necessary. Results of a recent calibration of PWR-1 core thermocouples indicate that shifts in thermocouple correlation factors with time are generally less than 1°F and that the great majority of core thermocouples remain operable. Core 1 flow coast-down tests were evaluated. Seed 2 flow rates were measured and found to agree with prediction within experimental accuracy. Power Plant Support. Procedures were developed to prevent corrosion of 17-4 PH steel in the main coolant pumps during wet and dry layup. A procedure was developed to permit use of reactor power to heat the plant during a cold startup. A loop-scale decontamination test was carried out with a modification of the CODS-type solutions. (auth)

21844 (WCAP-1091) THERMAL AND HYDRAULIC CALCULATIONS FOR ANNULAR FUEL TUBES OF ONCE-THROUGH REACTOR. C. Hunin and L. S. Tong (Westing-

use Electric Corp. Atomic Power Dept., Pittsburgh). n. 30, 1959. 34p.

Methods are presented for calculating fuel and coolant mperatures, and the pressure drop through annular gaps the fuel tubes in once-through reactors. The analytical ethods and their related equations are discussed and eps which should be included in the technique are listed. .R.D.)

1845 (WCAP-4053) CVTR PROJECT: CAROLI-AS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. ONTHLY PROGRESS REPORT, MARCH 1961. (West-ghouse Electric Co. Atomic Power Dept., Pittsburgh). ontract AT(30-1)-2289. 27p.

Thermal bowing of the Phase II pressure tube was meas-ed. A temperature difference of 55°F between the inlet d outlet legs produced a movement of the bottom of the essure tube of 0.308", which is within the calculated lue. Phase II heat leakage tests prior to the endurance n demonstrated that the ball joint seal effectively reduced olant leakage between the baffles and the pressure tube. addition, the evacuated shroud acted as an effective in-ilator. The prototype cooling fixture, and the jumper con-ector and port test fitting were connected to water supplies d operation was checked out. Tests were continued on the ntrol rod drive train components using a gearmotor drive. ne 84 full-height pressure-tube core in the critical experi-ent was reduced to a 72-tube core by removing two out-de rows; 2.0% fuel was substituted for 1.1% fuel which was eviously located in the 2.0% enrichment region. The net fect was a very small loss of reactivity. WTR resumed eration on Cycle #12 on March 26, 1961. Capsules A-2 d A-4 were relocated to obtain more satisfactory flux nditions. The M-1 and M-3 capsules remained under ir-adiation having experienced approximately 10^{21} fast nvt. he dynamic loop experiment continues in operation having perienced 73 days of irradiation. Results of the feasibility udy on ultrasonic inspection of integrally finned tubing in-cate that such inspection can be satisfactorily performed. recommendation was made to discontinue work on CVTR el tubes with welded fins. End closure weld development sts resulted in achieving a yield of better than 90% includ-g second pass repairs. A study of the consequences of an xiliary power failure indicated that boiling in the moder-or tank would occur, and cause boiling of heavy water 12 22½ minutes after the power outage, depending on the echanism of the heavy-water steam escape. The time re-uired for boiling to lower the moderator level to the top the fuel would be in excess of two hours. No fuel damage ould occur during this period. Development of codes for e loss-of-coolant accident analysis was continued. A con-ergence problem was encountered during the final phase debugging the steady state portion of the ALPS Code. his instability was sufficiently reduced to use the steady ate routine in the transient portion of the ALPS Code. uth)

1846 (WCAP-4054) CVTR PROJECT, CARO-INAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., ONTHLY PROGRESS REPORT, APRIL 1961. (Westing-ouse Electric Corp. Atomic Power Dept., Pittsburgh). ontract AT(30-1)-2289. 26p.

The impulsive burst testing of Zircaloy-4 specimens as started. A fully annealed specimen was tested at room mperature with a steady internal pressure of 2400 psig nd a peak impulse pressure of 7200 psig. Rupture did ot occur after 36 cycles of such loading. The Zircaloy-tainless steel joint has undergone 630 out of an ultimate tal of 1200 cycles with variation of temperature, pressure and bending, simulating startup and shutdown of the reactor. No leakage was detected during these tests. The change-over of one of the Phase II three-baffle assemblies to a four-baffle assembly was begun. Disassembly of the fuel assembly was completed without incident and the buildup to the four-baffle configuration is underway. The fission gas release in the hot rod over the entire core life of 31,600 hr was estimated to be 14.5%. Difficulty was experienced in the testing of the control rod drive power unit. The clutch had a tendency to slip and because of poor alignment, the servomotor shaft sheared. Adjustments were made to the clutch and a new motor ordered. Work at the critical facility continued with the 72-fuel-assembly core. Power maps, rod worths, and coolant void coefficients were measured. The CVTR Irradiation Program continued on schedule during the period. The A-2 and A-4 fuel pellet capsules and the M-1 and M-3 materials capsules remained in the WTR. The in-pile loop continued to operate satisfactorily. Metallographic examination of the rabbit capsules was continued. Debugging of the transient portion of the ALPS code for the loss of coolant analysis was also continued. (auth)

21847 (YAEC-139) THERMAL DEFLECTION OF THE YANKEE FIRST CORE FUEL ASSEMBLY. Harold Chelemer (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Jan. 1961. For Yankee Atomic Electric Co., Boston. Contract AT(30-3)-222, Subcontract No. 1. 67p.

Temperature gradients in the Yankee core result in thermal deflections of the Core I fuel assemblies. An experimental apparatus is used to apply different temperature gradients to a full scale fuel assembly and measure the accompanying thermal deflections. The results agree well with deflections predicted from a modified beam theory. The minimum available clearance for thermal deflection of the fuel assembly is more than twice the expected maximum deflection of 0.047 in. occurring in the core. (auth)

21848 THE FUEL ELEMENTS OF GRAPHITE-MODERATED REACTORS COOLED WITH CO_2 UNDER PRESSURE. J. A. Stohr (Centre d'Etudes Nucléaires, Saclay, France). Atompraxis, 7: 189-93(May 1961). (In French)

The kwh price of energy produced by a nuclear reactor depends to a great extent on the fuel elements. The individual cost items for the fuel elements are interrelated in a complicated manner. They include various factors: reactivity costs, behavior under irradiation, manufacturing costs, behavior in the reactor core, and specific output. Maximal performance can be reached only by a compromise between physical, metallurgical, manufacturing, and operational considerations. The results of studies made in the Commissariat à l'Energie Atomique Français are surveyed, and the conclusions reached on the basis of present knowledge are discussed. (auth)

21849 NUCLEONICS IN FLIGHT. N. M. Schaeffer. Nuclear Eng., 6: No. 60, 199-201(May 1961).

Nuclear-propelled aircraft, rockets, ramjets, and space nuclear auxiliary power are discussed in a general manner. Data are given on the Tory rocket reactors and the high temperature reactor experiment. Such topics as shielding, radiation damage, and reactor safety are also covered. (N.W.R.)

21850 THE STEAM COOLED HEAVY WATER MARINE REACTOR. Nuclear Eng., 6: 235-52(June 1961).

The British Steam Cooled Heavy Water Reactor (SCHWR) is described. General and mechanical design features are outlined. The thermo-compressor for steam circulation is analyzed. Plant performance and fuel eco-

nomics are examined. The physics and hazard control aspects of operation are considered. The reactor is presently in the design stage. (T.F.H.)

21851 MIXED GAS-STEAM CYCLES FOR NUCLEAR ENGINE APPARATUS. Sabino Roccotelli (Università, Naples). Tecnica ital., 25: 481-5(Oct.-Nov. 1960). (In Italian)

Power reactors based on a mixed gas-steam heat transfer cycle are analyzed and compared to gas and water cooled reactors. The advantages of each type are indicated. (P.C.H.)

21852 FLOOD SAFETY IN FAST SPECTRUM SUPERHEATERS. A. B. Reynolds and B. Wolfe (General Electric Co., San Jose, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 19-20(June 1961).

21853 MODERATOR CONTROL IN SOLID-MODERATED REACTORS. B. A. Engholm and A. I. Chalfant (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 20-1(June 1961).

21854 CONTROL SYSTEM FOR THE ML-1 NUCLEAR POWER PLANT. H. DeCovnick (Aerojet-General Nucleonics, San Ramon, Calif.). Trans. Am. Nuclear Soc., 4: No. 1, 25-6(June 1961).

21855 CONCEPTUAL DESIGN OF A COUPLED FAST-THERMAL STEAM SUPERHEATING REACTOR. R. R. Rohde, R. Avery, W. V. Dewey, and B. J. Toppel (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 34-5(June 1961).

21856 CONCEPT AND DESIGN OF A 400 Mwe INTEGRAL BOILING AND SUPERHEATING REACTOR. J. H. Wright and S. N. Tower (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 36(June 1961).

21857 STABILITY AND RESPONSE OF NUCLEAR ROCKET ENGINES. H. P. Smith, Jr. (Univ. of California, Berkeley) and A. H. Stenning. Trans. Am. Nuclear Soc., 4: No. 1, 87-8(June 1961).

21858 COMPARISON OF YANKEE SYSTEMS DESIGN AND OPERATING PERFORMANCE. A. R. Collier (Westinghouse Electric Corp., Pittsburgh) and W. J. Schmidt. Trans. Am. Nuclear Soc., 4: No. 1, 94-5(June 1961).

21859 TRANSIENT OPERATION OF THE YANKEE ATOMIC POWER PLANT. J. M. Gallagher (Westinghouse Electric Corp., Pittsburgh) and J. E. Howard. Trans. Am. Nuclear Soc., 4: No. 1, 95-6(June 1961).

21860 EXPERIMENTAL EVALUATION OF CORE REACTIVITY AND CONTROL ROD WORTH. J. E. Howard (Yankee Atomic Electric Co., Boston) and D. Hunter. Trans. Am. Nuclear Soc., 4: No. 1, 96-7(June 1961).

21861 COMPARISON OF PREDICTION WITH EXPERIMENT REACTIVITY AND CONTROL ROD WORTHS. H. W. Graves, Jr. and R. F. Janz (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 97(June 1961).

21862 EVALUATION OF REACTIVITY COEFFICIENT IN THE YANKEE REACTOR. D. Hunter (Westinghouse Electric Corp., Pittsburgh), C. G. Poncelet, H. W. Graves, Jr., and J. E. Howard. Trans. Am. Nuclear Soc., 4: No. 1, 97-8(June 1961).

21863 EVALUATION OF POWER DISTRIBUTIONS AND THE IN-CORE INSTRUMENTATION SYSTEM. D. Hunter (Westinghouse Electric Corp., Pittsburgh), J. D. McGaugh, H. W. Graves, Jr., and J. E. Howard. Trans. Am. Nuclear Soc., 4: No. 1, 98-9(June 1961).

21864 MAJOR LESSONS OF OPERATION. R. J. Coe (Yankee Atomic Electric Co., Boston). Trans. Am. Nuclear Soc., 4: No. 1, 99(June 1961).

21865 REACTIVITY MEASUREMENTS IN THE CAROLINAS VIRGINIA TUBE REACTOR CRITICAL EXPERIMENTS. P. W. Davison (Westinghouse Electric Corp., Pittsburgh), G. N. Hamilton, D. F. Hanlen, and J. B. Wright. Trans. Am. Nuclear Soc., 4: No. 1, 107-8 (June 1961).

21866 POWER AND FLUX DISTRIBUTIONS IN THE CAROLINAS VIRGINIA TUBE REACTOR CRITICAL EXPERIMENTS. J. A. Roll (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 108-9 (June 1961).

21867 PM-1 ZERO POWER TEST EXPERIMENTAL STUDIES. H. B. Rosenthal (Martin Co., Baltimore). Trans. Am. Nuclear Soc., 4: No. 1, 111(June 1961).

21868 INITIAL CRITICALITY AND EXPERIMENTS ON N. S. SAVANNAH CORE I. R. M. Ball and A. L. MacKinney (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Am. Nuclear Soc., 4: No. 1, 112-13(June 1961).

21869 MEASUREMENT AND ANALYSIS OF POWER DISTRIBUTION IN A HIGH PERFORMANCE PWR (SM-2). P. E. Bobe, B. E. Fried, T. M. Raby, and R. A. Robinson (Alco Products, Inc., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 116-17(June 1961).

21870 THE ROLE OF THE HUMAN CONTROLLER IN NUCLEAR POWER STATIONS: IMPLICATIONS FOR CONTROL ROOM DESIGN. H. M. Bowen, J. H. Ely, and D. S. Miquelon (Dunlap and Associates, Inc., Stamford, Conn.). Trans. Am. Nuclear Soc., 4: No. 1, 140-1(June 1961).

21871 MECHANICAL DEVELOPMENT OF CAROLINAS VIRGINIA TUBE REACTOR PRESSURE TUBES. A. Selz (Westinghouse Electric Corp., Pittsburgh). Trans. Am. Nuclear Soc., 4: No. 1, 141-2(June 1961).

21872 SUMMARY OF SM-1 PHYSICS MEASUREMENTS THROUGH END-OF-CORE LIFE. S. H. Weiss, S. N. Kemp, E. W. Schrader, and F. G. Moote (Alco Products, Inc., Schenectady, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 145-6(June 1961).

21873 DIMENSIONAL STUDIES OF SIMULATED EXPERIMENTAL GAS-COOLED REACTOR FUEL ELEMENTS AT ELEVATED TEMPERATURES. W. R. Martin (Oak Ridge National Lab., Tenn.). Trans. Am. Nuclear Soc., 4: No. 1, 149-50(June 1961).

21874 CONCEPTUAL PROMPT POWER EXCURSIONS IN PROPULSION REACTORS. W. R. Stratton (Los Alamos Scientific Lab., N. Mex.). Trans. Am. Nuclear Soc., 4: No. 1, 164(June 1961).

21875 STATUS OF THE SNAP 2 REACTOR. R. D. Keen and R. R. Eggleston (Atomics International, Canoga Park, Calif.). p.281-90 of "Space Power Systems." Nathan W. Snyder, ed. New York, Academic Press, 1961.

The development of the Systems for Nuclear Auxiliary Power (SNAP-2) reactor is reviewed. The hardware phase began with the Zero Power Critical Assembly Machine. Information gained from this equipment led to the construction of the first SNAP-2 power demonstration reactor known as the SNAP Experimental Reactor (SER). Operating experience and concurrent optimization of this reactor design resulted in a "second generation" compact nuclear power reactor. This reactor incorporates vehicle integration and

l flight configuration considerations. The design for reactor was completed and construction is underway. h)

76 SNAP II POWER CONVERSION STATUS. D. L. ham (Thompson Ramo Wooldridge, Inc., Cleveland). 1-300 of "Space Power Systems." Nathan W. Snyder, New York, Academic Press, 1961.

review of the current development status of the com- d rotating unit, the boiler superheater, and the load rol is presented. The experimental performance racteristics of each of the components are discussed respect to the expected influence on system opera- . The critical development areas remaining for the er conversion system are presented. (auth)

77 METHOD FOR THE CONVERSION OF EXCESS ERGY FROM NUCLEAR POWER. Fritz Marguerre. tish Patent 866,939. May 3, 1961.

method for the thermodynamic storage of excess energy n a nuclear power station is described. It has a cooling tem, wherein the excess energy is used to remove heat n the cooling system and to pass it at a higher tempera- to an accumulator, and wherein the stored energy is ained by making use of the temperature difference be- en the accumulator and the available ambient tempera- e. To carry out this method a low pressure accumulator connected to the heated side of the cooling system, a n pressure accumulator is connected to the input of a am or gas turbine, and a compressor, arranged to be wen by the excess energy, is connected between the low- ssure accumulator and the high-pressure accumulator. W.R.)

78 IMPROVEMENTS IN OR RELATING TO NU- EAR REACTORS. Ian Douglas Neilson (to Hawker Sid- ey Nuclear Power Co., Ltd.). British Patent 868,627. y 25, 1961.

nuclear reactor and method for producing superheated am for electricity generation or for the generation of chanical power such as the main propulsion machinery ships is described. The reactor consists of a core pted to contain fissile material and means for passing anic liquid coolant through different parts of the core wo coolant paths. When the reactor is in operation, st of the organic coolant passes through a first coolant h to remove the greater part of the heat generated in core. The remainder of the coolant passes through the ond path to emerge from the core at a higher tempera- e than from the first path. The second coolant passes ough the reactor at least twice and leaves through its n outlet. An evaporator is connected in circuit with the st coolant path so that the coolant in this path passes m the reactor core to the evaporator. A superheater connected in circuit with the second path so that the lant passes from the reactor core to the superheater. W.R.)

79 IMPROVEMENTS IN OR RELATING TO NU- EAR REACTORS. Herbert Chilvers Knights (to United gdom Atomic Energy Authority). British Patent ,677. May 25, 1961.

A simple and reliable restraint for a moderator and lector structure suitable for use in a nuclear reactor lt into a moving body is described. The restraint may o be used with a graphite moderator structure in which blocks are unspaced from one another. The restraint sists of rings of restraint shoes around the structure viding a radially acting restraint force and torque tubes loading the shoes against the structure. The shoes are loaded by lever arms attached to the torque tubes and all arms are connected together to rotate in unison. The device also contains means for relaxing the load in the torque tubes when the load exceeds a predetermined amount, by a degree sufficient to ensure that adequate static loading of the moderator structure is maintained. The load is relaxed by deformable members of the torque tubes which allow the untwisting of the torque tubes and a stop is provided such that the untwisting will stop when the amount of unloading necessary to maintain the static moderator is met. (N.W.R.)

21880 NUCLEAR REACTOR FOR GENERATION OF POWER AND FOR IRRADIATION OF A LIQUID ORGANIC MATERIAL. (to Esso Research and Engineering Co.). British Patent 868,766. May 25, 1961.

A thermal reactor, for the heating of a fluid heat carrier and for the irradiation of organic materials in liquid or vapor phase, is described. The reactor comprises, in combination, a reaction chamber containing fissile material in an amount sufficient to sustain a nuclear reaction, conduit means for supplying fluid coolant to and for removing coolant from the reaction chamber, thermal insulation disposed about the chamber in heat insulating relationship, a radio-conversion reaction chamber disposed about the thermal insulation and providing a passageway for the organic material, and conduits adapted to admit the organic material to and remove it from the radio-conversion reaction chamber. The chamber is so disposed with respect to the reaction chamber that the organic material passing through it absorbs at least 1% of the energy released in the reaction chamber and provides at least 25% of the moderation required for the reaction. The thermal insulation in the reactor is so arranged that there is a temperature difference of at least 50°F between liquid coolant in the reaction zone and liquid or vapor phase organic material in the radio-conversion reaction zone. A process for increasing the enthalpy of a fluid heat transfer medium and for the irradiation of a liquid organic material using this reactor is described. (N.W.R.)

21881 IMPROVEMENTS IN BOILING REACTOR. (to Nuclear Development Corp. of America). British Patent 869,314. May 31, 1961.

A boiling water reactor and a power producing system comprising this reactor is described. The reactor consists of a plurality of elongated fuel tubes arranged in a lattice array. Each tube has a plurality of rods of fissionable uranium and has a plurality of coolant passages in close proximity to the fuel rods. Ordinary water in the passages is used for absorbing the heat generated in the fuel rods. The ordinary water generally exists partly in liquid and partly in vapor when the reactor is in operation. There is a tank surrounding the fuel tubes and containing the heavy water. The weight ratio of heavy water to fissionable uranium is in excess of one and the distribution and relative proportions of fissionable uranium heavy water, and ordinary water being such that the excess reactivity of the reactor due to variations in the ordinary water in the liquid and vapor phases is less than one dollar when the average density of ordinary water is a minimum for the reactor. Furthermore any increase in the average density of ordinary water in the reactor results in a decrease in excess reactivity. When the moderating substance (heavy water, beryllium, or graphite) has a ratio greater than ordinary water and the excess reactivity of the reactor is controlled by the parasitic absorption of neutrons by the ordinary water, the average density of the ordinary water in the reactor results in an increase in excess re-

activity. The power producing system is designed which connects the reactor with a saturated vapor cooled reactor. The coolant channels of the boiling reactor are connected to the heating tubes of the vapor reactor. There are means for separating the liquid water from the saturated water vapor and pipes for delivering the water vapor to the heating tubes. A turbine is adapted to be driven by steam. There are means connecting the heating tubes to the input stage of the turbine and means for varying the amount of steam delivered to the turbine in accordance with variations in the load upon the turbine. (N.W.R.)

21882 LIQUID COOLED NUCLEAR REACTOR. Siegfried Uthe (to Siemens-Schuckertwerke A. G.). Canadian Patent 613,363. Jan. 24, 1961.

A nuclear reactor with high operating pressure, such as a pressurized water reactor, in which the coolant is maintained in a liquid state in the pressure vessel rather than being evaporated is described. The reactor consists of an active lattice with a space below the lattice in the vessel in which vaporized coolant is maintained at a pressure sufficient to maintain the coolant surrounding the active lattice in a liquid state. There are two compartments in the vessel, one containing the active lattice and being filled with coolant, the other containing heating means and being partly filled with liquid coolant and containing permeable plugs. The heating means vaporizes coolant in the upper compartment. The pressure is transmitted to the lower compartment by the permeable plugs. The vaporized coolant is generated outside the reactor vessel and there are means for injecting liquid coolant into the vaporized coolant thereby reducing the pressure of the vaporized coolant. (N.W.R.)

21883 POWER PLANTS. Pierre H. Pacault and Jean F. Tillequin (to Babcock and Wilcox, Ltd.). Canadian Patent 614,134. Feb. 7, 1961.

A nuclear power plant is described. The plant consists of an elastic fluid engine means including a plurality of pressure stages. There are two heat exchangers arranged to be heated by the fluid heat carrier from the reactor. The exchangers are adapted to produce elastic fluid for the engine means by the evaporation of a liquid. There are two economizers arranged to be heated by the fluid heat carrier and to supply heated liquid to the individual heat exchangers for evaporation. There are two reheaters disposed adjacent the engine means and arranged to receive part of the heated liquid from the individual economizers and to transfer heat from that liquid to elastic fluid flowing from the high pressure stage to the low pressure stage of the engine means. There are pump means arranged to return the cooled liquid to a point in the economizer which is subsequent to the inlet for cold feed liquid into the economizer. (N.W.R.)

21884 HEAT REMOVAL SYSTEM FOR NUCLEAR REACTORS. Jean Le Foll and Gilbert Mélèse (to Commissariat à l'Energie Atomique). Canadian Patent 618,243. Apr. 11, 1961.

A heat removal system for a nuclear reactor which includes a matrix of moderator material forming a multiplicity of substantially parallel channels and fuel rods in the channels is described. The system has means for feeding a coolant to a group of the channels at the inlets, the coolant is at a given temperature at the channel inlets. There are means for forming two separate chambers for collecting coolant from the outlets of the channels, one chamber is in communication with a plurality of the last mentioned channels forming a first sub-group and the other chamber is in communication with the others of the last mentioned channels forming a second sub-group, the conditions of flow through the sub-groups is different. There is a jet pump having a driving fluid means in communication with one of the chambers and driven fluid inlet means in communication with the other of the chambers. (N.W.R.)

21885 COOLANT-MODERATOR CIRCULATION SYSTEM FOR HETEROGENEOUS NUCLEAR REACTORS. Hermann Kumpf and Robert Weber (to Siemens-Schuckertwerke A. G.). Canadian Patent 618,733. Apr. 18, 1961.

A cooling system for a heterogeneous power reactor is described. The thermal reactor contains fuel-receiving cooling channels which jointly define a core zone and contains an enclosed moderator space surrounding the core zone. There is a primary circulation system for coolant-moderator liquid, the system includes the cooling channels and has a portion external of the reactor. There is a secondary conduit system for working medium, a heat exchanger in the external portion of the primary system for transferring heat to the working medium, and conduit means branching off the external portion of the primary system at a point located behind the heat exchanger relative to the flow direction of the liquid and communicating with the moderator space for supplying it from the primary system with a fractional amount of the liquid as required for moderating purposes. There is also a cooling device inserted in the conduit means for reducing the temperature of the fractional amount of liquid. (N.W.R.)

21886 NUCLEAR FISSION PROCESS AND REACTOR THEREFOR. Bernard L. A. van der Schee (to Stichting Reactor Centrum Nederland). Canadian Patent 619,547. May 2, 1961.

A thermal power reactor using a suspension of solid fissile material in a moderating carrier which is continuously circulated so as to pass upward through a reactor vessel from at least one inlet is described. The greater part of the liquid circulating through the vessel is conducted vertically through a uniform cross section and the suspension is caused to ascend through the path in laminar flow. The velocity of the upward flow is greater than the settling rate of the fissile material in a static body of the liquid and the fissile material continuously entering the path is in such concentration in the carrier liquid that the concentration of the suspension considered along any vertical path is substantially uniform. The reactor contains a bottom inlet or inlets, a system of internal guide walls above the inlets and at or near the bottom of each passage, the walls being adapted to suppress horizontal currents in the suspension liable to create turbulence, and outlets at the top through which suspension ascending in laminar flow along the passages may pass without any substantial turbulence. (N.W.R.)

Production Reactors

21887 FEASIBILITY STUDY OF THE URANIUM-233–THORIUM FAST BREEDER REACTOR SYSTEM. A. J. Goldman (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 33(June 1961).

21888 CONCEPTUAL DESIGN OF A STEAM COOLED FAST BREEDER REACTOR. G. A. Sofer and R. D. Hankel (Nuclear Development Corp. of America, White Plains, N. Y.). Trans. Am. Nuclear Soc., 4: No. 1, 35-6(June 1961).

Research Reactors

21889 (SCDR-337-60) FABRICATION OF WELDED VESSEL FOR THE SANDIA ENGINEERING REACTOR. V. G. Nelson (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 17p.

The selection of the specific alloys used, the fabrication procedures, and the quality control measures involved in the construction of the pressure vessel for the Sandia Engineering Reactor are described. (auth)

21890 PURIFICATION OF WATER FOR THE SWIMMING POOL REACTOR JEN-1. I. STUDY OF LABORATORY SCALE DEIONIZING SYSTEMS. J. A. Pérez Bustamante, M. Urgell Comas, T. Batuecas Rodríguez, F. de la Cruz Castillo, and R. Fernández Cellini (Junta Energia Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. B, 57: No. 1, 29-38(Jan. 1961). (In Spanish)

Different types of water deionizing assemblies in laboratory-scale, including separated and mixed beds, were studied. Several resin types were used in order to choose the most suitable ones to be used in the demineralized water feed unit for the swimming pool of the JEN-1 Reactor. (auth)

21891 IRRADIATIONS AND REACTOR LOOPS. M. Seguin. Bull. inform. sci. et tech. (Paris), No. 48, 55-60(Feb. 1961). (In French)

Reactor loops were developed for two principal study purposes: the study of the variations of the physical properties of graphite and the study of the behavior of the graphite at high temperatures and under pressure in the presence of heat transfer gases such as CO_2. These two types of installations are described. A hot box for the recovery of active samples is also described. (tr-auth)

21892 ANALYSIS OF POSSIBLE ACCIDENTS IN THE PRIMARY COOLANT CIRCUIT ON THE JEN-1 REACTOR. M. Carreira and P. Luis Y Luis. Energia nuclear (Madrid), 5: No. 17, 20-7(Jan.-Mar. 1961). (In Spanish)

The transitory states produced in four types of accidents in the primary coolant circuit of the JEN-1 Reactor are analyzed. The four accidents considered are: (a) The reactor is operating at maximum power and the power supply fails. Pumping in the primary system stops. When the coolant flow is reduced to 20% of its normal value, the emergency aperture is opened, equivalent to introducing in the circuit an orifice with coefficient equal to 0.65. (b) This accident is identical to the above, but the emergency aperture does not open. (c) The reactor is operating at maximum power and the pump shaft freezes. When the flow is reduced to 20% of its normal value, the emergency gate opens. (d) The last accident is identical to the above, but the emergency gate does not open. (J.S.R.)

21893 PRELIMINARY DESIGN OF A BASIC RADIATION EFFECTS REACTOR (BRER). D. R. MacFarlane, I. Charak, R. R. Rohde, B. J. Toppel, and H. Unger (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 33-4(June 1961).

21894 CRITICAL EXPERIMENTS FOR THE PRELIMINARY DESIGN OF THE ARGONNE HIGH FLUX REACTOR, PART A. J. W. L. DeVilliers, Q. L. Baird, J. Juliano, C. N. Kelber, R. Kiyose, and K. E. Plumlee (Argonne National Lab., Ill). Trans. Am. Nuclear Soc., 4: No. 1, 109-10(June 1961).

21895 CRITICAL EXPERIMENTS FOR THE PRELIMINARY DESIGN OF THE ARGONNE HIGH FLUX REACTOR, PART B. J. O. Juliano, C. N. Kelber, and K. E. Plumlee (Argonne National Lab., Ill.). Trans. Am. Nuclear Soc., 4: No. 1, 110-11(June 1961).

21896 CRITICAL EXPERIMENTATION ON PROJECTED LOOP IRRADIATIONS IN THE WESTINGHOUSE TESTING REACTOR. A. B. de Saint Maurice (Westinghouse Electric Corp., Waltz Mill, Penna.). Trans. Am. Nuclear Soc., 4: No. 1, 113-15(June 1961).

21897 CONTROL OF OPEN POOL REACTOR SURFACE DOSE IN THE 5 TO 15 MEGAWATT POWER RANGE. P. E. Thurlow (AMF Atomics, Greenwich, Conn.). Trans. Am. Nuclear Soc., 4: No. 1, 143(June 1961).

WASTE DISPOSAL AND PROCESSING

21898 (HW-SA-2053) THE INFLUENCE OF RADIOLOGICAL WASTES ON WATER QUALITY. R. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 28, 1960. Contract AT(45-1)-1350. 11p.

Presented at the Conference on Water Quality in the Columbia River Basin on November 28-30, 1960, in Pullman, Washington.

The factors involved in judgement of water quality from the standpoint of radionuclide contamination are discussed. The potential sources of radionuclides in the Columbia River are outlined, and radionuclides in the river which contribute most to exposure of the gastro-intestinal tract are discussed. Probable percentages of the maximum permissible concentrations received by people exposed to the river in all possible ways are estimated. The outlook for the future regarding the radionuclide level in Columbia River is discussed. (D.L.C.)

21899 (HW-SA-2156) LIQUID WASTE MANAGEMENT PLANNING FOR THE PLUTONIUM RECYCLES TEST REACTOR. W. A. Haney, G. E. Backman, and D. R. Koberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 18, 1961. Contract AT(45-1)-1350. 21p.

An evaluation of the Plutonium Recycle Test Reactor (PRTR) waste management program is presented. It is noted that the PRTR is an inherently safe reactor designed to contain radioactive materials released in a plausible nuclear incident. Waste disposal limits were established and monitoring facilities provided to prevent the chronic discharge of excessive amounts of radionuclides. The PRTR waste disposal program is designed so that very stringent limits will not be exceeded. (J.R.D.)

21900 (CEA-tr-A-892) ELIMINATION DES DECHETS RADIOACTIFS. (Disposal of Radioactive Wastes). T. Jaeger. Translated into French from Atomkernenergie, 3: 190-6(1958). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 9774.

21901 THE DECONTAMINATION OF RADIOACTIVE LIQUID WASTES. S. Donato, A. Facchiai, A. Pizziolo, C. Tribuno, and E. Zamorani. Acqua Ind., 2: No. 7-8, 85-103(1960).

A study of the decontamination of radioactive wastes by coprecipitation, adsorption and ion-exchange methods is presented. Continuous mixed treatment is proposed for the decontamination of a mixture containing fission products. (auth)

21902 LABORATORY WORK ON CERTAIN ASPECTS OF THE DEEP WELL DISPOSAL PROBLEM. W. J. Lacy (Oak Ridge National Lab., Tenn.). Health Phys., 4: 228-32(1961).

If there is sorption near the point of injection of the radioactive waste into a well, the concentration of activity per cubic foot may present a heat production problem due to radioactive decay. Cesium is a long-life fission product known to be easily sorbed by clays. The amount of cesium sorbed was found to be a function of several variables: (1) concentration of cesium in the waste; (2) concentration of other cations in the waste; (3) amount and nature of the clay present; (4) composition and amounts of other minerals in the formation; and (5) hydrogen ion concentration of the waste. Illite sorbed 3.5 mg of Cs per 10 g of clay from a simulate 6 M neutralized Purex-type waste solution, while kaolinite sorbed 1.1 mg per 10 g, and halloysite less than 0.5 mg of Cs. Increasing the sodium ion concentration from 0.5 to 6.0 M decreased the amount of Cs sorbed from 1.02 to 0.39 mg per g of clay. Decreasing the Cs concentration from 100 to 10 mg/l resulted in a decrease in the amount of Cs sorbed from 0.35 to 0.11 mg/g of clay. A mixture of small amounts of limestone with illite reduced the uptake of Cs from neutralized Purex waste. About three times as much Cs was removed from a Na neutralized solution as from an acid solution. The use of competing ions, like Na and Ca or the control of the Na/Cs ratio can limit the sorption of Cs within the range where localized concentration of heat will not represent a hazard to waste disposal through deep well injection. (auth)

21903 PROPERTIES AND USES OF A UNIQUE CERAMIC CARRIER FOR RADIOACTIVE ISOTOPES. T. N. Lahr and J. P. Ryan (Minnesota Mining & Mfg. Co., St. Paul). Trans. Am. Nuclear Soc., 4: No. 1, 126(June 1961).

21904 RADIOACTIVE WASTE HANDLING IN THE NUCLEAR POWER INDUSTRY. A Report of the Technical Appraisal Task Force on Nuclear Power to the Board of Director of the Edison Electric Institute. EEI Publication No. 60-46. New York, Edison Electric Institute, 1960. 93p. $5.00.

Problems and prospects in the handling of radioactive wastes from reactors, fuel processing plants, and nuclear weapons are studied. Outlines are given of the primary sources of radioactive materials and the types, effects, and permissible doses of radiation. Methods for containment or dispersal of gaseous, liquid, and solid wastes are described. Economics, regulations, standards, and insurance aspects of waste handling are studied. Waste handling at the six large U. S. power reactors—Shippingport, Yankee, Indian Point, Dresden, Enrico Fermi, and Hallam—are discussed. Normal and abnormal wastes, wastes from accidents, and utilization of wastes are investigated. (T.F.H.)

21905 SHAFT FURNACE FOR INCINERATION OF WASTES. (to Michaelis Industrieofenbau). Belgian Patent 596,517. Priority date, Oct. 29, 1959.

An entirely automatic furnace specially designed for radioactive waste disposal is described. Heat can be generated by gas, oil, or electricity. The wastes are torn into small pieces by a special multiblade cutter inside the furnace which is fitted with a removable sole plate. The radioactive ash is removed in containers placed in a pit under the sole-grid. The whole equipment is fully shielded against radiation. (EURATOM)

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